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All communications intended for the "Publications" should be addressed to the editor, Dr. H. Utinomi, The Laboratory, Sirahama, Wakayama Prefecture.

REPORT ON THE PYCNOGONIDA COLLECTED BY THE SÔYÔ-MARU EXPEDITION MADE ON THE CONTINENTAL SHELF BORDERING JAPAN DURING THE YEARS 1926–1930[1)]

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With 24 Text-figures

This paper is the result of an examination of the pycnogonids collected on the continental shelf bordering Japan by the surveying ship Sôyô-maru of the Imperial Fisheries Experimental Station (now the Tôkai Regional Fisheries Research Laboratory) during the years 1926–1930. Its study was originally assigned to Dr. Hiroshi Ohshima, then Professor of Zoology in the Kyusyu Imperial University, but after his retirement in 1946 from his teaching duties, was kindly transferred to the writer.

When the material here dealt with was entrusted to my care in 1953, it was found to be all but untouched by Dr. Ohshima himself and unfortunately the majority having been badly preserved in tubes, either scarcely filled with alcohol or dried up. Sometimes the legs and other delicate appendages were quite dissolved or damaged, or mostly lost. Yet identification proved to be mostly possible, for, apart from the taxonomically unimportant minor structures, each species possesses some characteristic features of its own.

As the result of an examination it was found that the specimens contained in 41 vials are referable to 24 species, belonging to 11 genera, of which 4 are considered new to science. All these specimens, including the types, are now preserved in the zoological collection of the Seto Marine Biological Laboratory at Sirahama. In the appended tables and chart is given the distribution of all species mentioned.

My special thanks are due to Dr. Hiroshi Ohshima for the privilege of studying these precious specimens, and to Prof. Yoshi-kuni Hiraiwa and Dr. Sadayoshi Miyake, of the Department of Zoology, Kyusyu University who were kind enough not only to entrust to me this collection, but also for permission to retain them for the Seto Marine Biological Laboratory. Further I wish to acknowledge my great indebtedness to Dr. J. H. Stock, of the Zoological Museum, Amsterdam, and to Dr. Joel W. Hedgpeth, of the Scripps Institution of Oceanography, La Jolla, California, for help with the literature and many other details relating to the species contained in this work.

1) Contributions from the Seto Marine Biological Laboratory, No. 267.

Table 1. List of Pycnogonida mentioned in this paper.
(* Hitherto not recorded from Japan)

Name of the species	Depth in m.	Observed outsides the Japanese waters
Nymphon grossipes KRØYER	43–270	Arctic-circumpolar
N. japonicum ORTMANN	61–986	—
N. braschnikowi SCHIMKEWITSCH	93–628	—
N. kodanii HEDGPETH	135–1168	—
N. micropedes HEDGPETH	86–909	—
N. ortmanni HELFER	108–360	—
**N. stocki* n. sp.	132–324	—
**N. soyoi* n. sp.	188	—
**N. falcatum* n. sp.	135–421	—
**Parapallene nierstraszi* LOMAN	0–112	East Indies, South Africa
Pallenopsis sibogae LOMAN	36–162	East Indies
Phoxichilidium ungellatum HEDGPETH	147–1057	—
Achelia superba (LOMAN)	36–180	—
Ascorhynchus japonicum IVES	100-1652	—
A. cryptopygium ORTMANN	108–270	—
A. glabroides ORTMANN	72–250	—
A. glaberrimum SCHIMKEWITSCH	93	—
Cilunculus armatus (BÖHM)	65-628	Okhotsk Sea
Heterofragilia amica STOCK	162–203	—
**Scipiolus spinosus* n. sp.	71	—
Colossendeis dofleini LOMAN	181–770	—
C. chitinosa HILTON	56–770	Alaska, Bering Sea
C. nasuta HEDGPETH	519–704	—
Pycnogonum tenue (SLATER)	61-274	—

Some Zoogeographical Remarks

Our present knowledge on the Japanese pycnogonid fauna is largely due to the works of OHSHIMA (1936 and others), HEDGPETH (1949) and STOCK (1954). Most of the faunal elements elucidated by these eminent workers are confined to rather deep-water forms, since they have dealt with for the most part the collections taken by various foreign expeditions in the Okhotsk and Japanese Seas. Some of the eulittoral and shallow-water forms are found in their works, but most are practically almost unknown, except for the region of Hokkaido once studied by me (UTINOMI, 1954). Hence it is rather risky to draw conclusions from the insufficient material.

OHSHIMA (1936) gave a list of the pycnogonids so far recorded from Japanese and adjacent waters, including the Chinese and Siberian coasts. In that list he enumerated 41 pycnogonids, comprising 34 species, 3 varieties and 4 indeterminable forms. Since then, HEDGPETH (1949) also listed 65 definite species and 6 indetermin-

able species or forms, by the acquisition of rich materials collected by the Albatross Expedition in 1900 and 1906. Very recently, STOCK (1954) recorded 30 species from the collection made by Dr. Th. MORTENSEN in the years 1914–1916, including 6 new, 4 unknown and 2 indeterminable species.

The present Sôyô-maru material here dealt with, though not so rich in species as well as specimens, contains 24 species in all. The dredging operations were made by the S. S. Sôyô-maru at 658 stations, ranging between 18 and 799 meters in depth, and the successful catch for pycnogonids ranged from 64 to 539 meters. The pycnogonids were thus collected at about 6.23% of the stations occupied; this percentage of catch is very low, as compared with that taken by the Siboga in East Indies (12.4%) and that taken by the Albatross in Japan (20%).

Summing up all existing records, the Japanese pycnogonid fauna consists of about 22 genera and 99 species to date, not counting any invalid or indeterminable species ever recorded. They are:

Nymphon	24 spp.	*Nymphopsis*	1 sp.
Callipallene	5 spp.	*Ascorhynchus*	6 spp.
Propallene	1 sp.	*Cilunculus*	1 sp.
Parapallene	1 sp.	*Lecythorhynchus*	2 spp.
Pallenopsis	6 spp.	*Heterofragilia*	1 sp.
Decachela	1 sp.	*Scipiolus*	1 sp.
Phoxichilidium (s. lato)	6 spp.	*Nymphonella*	1 sp.
Pycnosoma	1 sp.	*Tanystylum*	2 spp.
Endeis	1 sp.	*Austrodecus*	1 sp.
Achelia	13 spp.	*Colossendeis*	7 spp.
Ammothella	2 spp.	*Pycnogonum*	5 spp.

Among them, about 24 are apparently shallow-water species, and it is expected that future extensive collecting survey specially in southern Japan, will reveal as many more than a rich lot of the species hitherto known.

Against our expectation, the present collection is represented by relatively few of the widely distributed or warm-water species that are known to occur throughout the Indo-West Pacific Region. As seen in Table 1, only two species are common to Japanese waters and the East Indies: *Pallenopsis sibogae* and *Parapallene nierstraszi*. *Pallenopsis mollissima, P. tydemani, P. virgata, P. temperans, Ascorhynchus auchenicum, Nymphopsis muscosa, Callipallene dubiosa* and *Endeis mollis*, all of which are not represented in the Sôyô-maru collection, are also included in the same category.

Apart from the cosmopolitan deep-water genus *Colossendeis*, there is but one common to both faunae, still extending the range of occurrence to South Africa: *Parapallene nierstraszi* (cf. BARNARD, 1954). It is rather strange that the other deep-water genera, such as *Nymphon* and *Ascorhynchus*, are well represented in Japanese waters by a number of endemic species; indeed, all the records taken by the Siboga (1899–1900), the Albatross (1900–1909) and the Snelius Expedition (1929–

1930) in the East Indian and Philippine waters gave no evidence to prove further southward extension of the range of the endemic forms in Japan (LOMAN, 1908; STOCK, 1953b, 1954).

The most noticeable fact, in this connection, is a refind of *Heterofragilia amica* and an occurrence of a new representative of the genus *Scipiolus*, regarded hitherto to be monospecific and endemic to East Indies. It is thus probable that both unique genera are not restricted to either of the two regions, but similar species or allies may also occur in both regions, as in the case of *Cilunculus*.

On the other hand, the boreal species are represented in the present collection by three deep-water species: *Nymphon grossipes*, *N. braschnikowi* and *Colossendeis chitinosa*. *Nymphon kodanii*, *N. micropedes* and *N. ortmanni* have hitherto been known only from Japanese waters south of latitude 36°N, while in the present collection they are recorded from regions north of 36°N. The distribution of *N. japonicum*, of which 33 specimens were captured from 15 stations, is the largest, crossing the boundary of 36°N. From the oceanographical point of view, especially in respect to the circulation of currents around the mainland of Japan, it is not surprising to find some warm-water forms (of course any endemic species as well) in the southern coast of Hokkaido and some cold-water forms in the Korea Strait.

Systematic Account

Family NYMPHONIDAE WILSON

Genus *Nymphon* J. O. FABRICIUS

1. *Nymphon grossipes* (O. FABRICIUS ?) KRØYER

(Fig. 1)

Nymphon grossipes HEDGPETH, 1948, pp. 187–188, fig. 13a; HEDGPETH, 1949, p. 247 (synonymy).

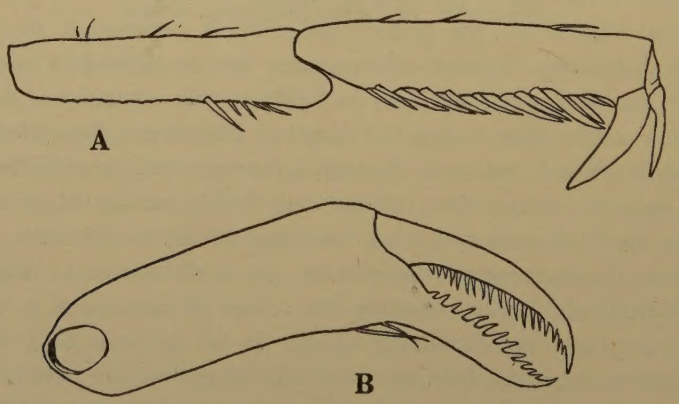

Fig. 1. *Nymphon grossipes* (O. FABRICIUS ?) KRØYER.
A, distal joints of leg; B, chela. (All ×27)

Material: 1 larvigerous male (Coll. No. 893)*, St. 269, off Simoda, Sagami Bay, 247 m. Nov. 18, 1927.

Remarks: All characters agree well with previous descriptions of this species, so some measurements are only given herein in mm.

Length of proboscis..... 0.4	Cephalic segment.....5.5
Length of trunk 10.0	Chela 3.0
Length of abdomen 1.5	Width across 2nd crurigers...3.0

This boreal Arctic species is hitherto known from the Siberian coast and Okhotsk Sea, north of 43°N. in the Northwestern Pacific, and from New England waters, north of 40°N. in the North Atlantic. Hence, this record extends the distributional range to the south of 35°N. Bottom temperature of the locality was 11.2°C.

2. *Nymphon japonicum* Ortmann

Nymphon japonicum Ortmann, 1891, pp. 158–159, Pl. 24 fig. 1; Hedgpeth, 1949, pp. 249–250, fig. 20; Utinomi, 1951, pp. 159–160; Stock, 1954, pp. 18–20, fig. 6a–c.

Material: 1 male (Coll. No. 920), St. 232, Tosabaé, SE. of Muroto-zaki, 269 m. July 30, 1927.

1 female and 1 ovigerous male, both red colored (Coll. No. 889), St. 239, off Misaki, Sagami Bay, 307 m. Nov. 6, 1927.

1 female (Coll. No. 890), St. 255, off Inatori, Sagami Bay, 263 m. Nov. 10, 1927.

3 specimens (Coll. No. 891), St. 258, off Irô-zaki, Suruga Bay, 432 m. Nov. 15, 1927.

1 specimen, dark brown in color (Coll. No. 892), St. 259, Suruga Bay, 188 m. Nov. 15, 1927.

1 juvenile, probably this species (Coll. No. 894), St. 270, Dôketuba, Sagami Bay, 91 m. Nov. 18, 1927.

1 female (Coll. No. 895), St. 279, Seno-umi, Suruga Bay, 155 m. July 2, 1928.

3 specimens, almost mutilated (Coll. No. 346), St. 286, Seno-umi, Suruga Bay, 123 m. July 4, 1928.

5 specimens, not fully matured (Coll. No. 365), St. 293, off Sata-misaki, Kagosima Pref., 203 m. July 10, 1928.

1 specimen, legs only remained (Coll. No. 907), St. 553, off Komatu, Isikawa Pref., 113 m. July 21, 1930.

1 male and 1 ovigerous male (Coll. No. 909), St. 568, N. of Noto Peninsula, 90 m. July 27, 1930.

3 specimens lacking the terminal segments, trunk damaged, but probably this species (Coll. No. 910), St. 575, N. of Noto Peninsula, 123 m. July 28, 1930.

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* Collection Number (Coll. No.) refers to the labels originally contained in the vials of the Sôyô-maru Collection.

2 specimens (Coll. No. 918), St. 610, NE. of Sado Island, 145 m. Aug. 10, 1930.

3 ovigerous males (Coll. No. 919), St. 618, S. of Tobi-sima, Yamagata Pref., 135 m. Aug. 14, 1930.

4 specimens, damaged (Coll. No. 922), St. 638, Nisitugaru Bank, Aomori Pref., 73 m. Aug. 18, 1930.

Remarks: This species is very common and apparently endemic in the Japanese waters, as collected at 15 stations during the Sôyô-maru Expedition, 9 on the Pacific coast and 6 in the Japan Sea.

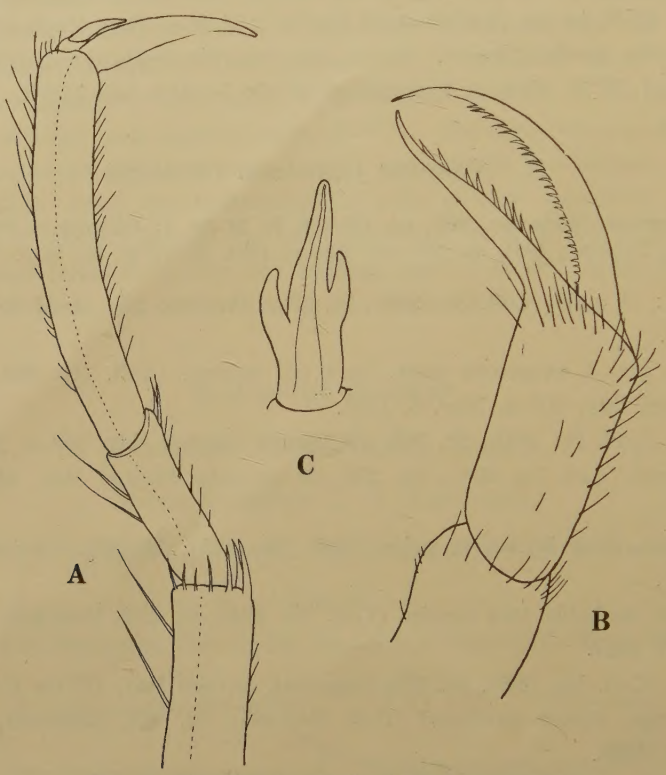

Fig. 2. *Nymphon braschnikowi* SCHIMKEWITSCH.
A, distal joints of leg; B, chela; C, compound spine of oviger.

3. *Nymphon braschnikowi* SCHIMKEWITSCH

(Fig. 2)

Nymphon braschnikowi SCHIMKEWITSCH, 1906, pp. 248–251; SCHIMKEWITSCH, 1930, pp. 507–512, figs. 154–160, Pl. IX figs. 1–2; OHSHIMA, 1936, p. 863 (listed); HEDGPETH, 1949, p. 250, fig. 21a–c.

Material: 1 ovigerous male (Coll. No. 879), St. 57, off Miyako, Iwate Pref., 494 m. July 18, 1926.

Remarks: The specimen is referable to this species, described only by two authors. The chelae and the terminal joints of legs resemble those figured by HEDGPETH rather than those of the type. According to the original description, the spine formula of the oviger joints is 7–8 : 5 : 5 : 6 : : 6 and their compound spines are armed with 3 pairs of denticulations. In the present specimen, however, the spine formula is 7 : 5 : 4 : 5 : : 10 and each spine possesses only one pair of denticulations.

The "Albatross" record of occurrence of this species is not as far south as 42°N. The present record (39°44′36″ N.) extends its range farther southwards.

Measurements of a male (in mm)

Length of proboscis	1.8	femur	5.0
Length of trunk	5.5	tibia 1	5.0
Length of abdomen	1.5	tibia 2	7.5
Third leg :		tarsus	1.0
coxa 1	1.0	propodus	2.3
coxa 2	3.0	claw	1.0
coxa 3	1.0	auxiliaries	0.3

4. *Nymphon kodanii* HEDGPETH

(Fig. 3)

Nymphon kodanii HEDGPETH, 1949, pp. 252–254, fig. 23; STOCK, 1954, p. 21, fig. 6f.

Material: 1 larvigerous male (Coll. No. 921), St. 630, off Oga Peninsula, Akita Pref., 150 m. Aug. 17, 1930.

Remarks: This species is characterized by the shape of chela, the fourth joint of palp which is shorter than the fifth and the very setose legs, but the relative length of the joints of legs and the setation of the trunk and legs may be subject to considerable variation.

In the present specimen, all legs are very setose and the median joints are comparatively longer than in HEDGPETH's specimens, as shown by the measurement given below. Tarsus and propodus are considerably shorter than the tibiae and with a row of densely-set spines on the ventral surface and also with a row of moderately spaced spines on the lateral surfaces. Terminal claw slightly curved, about two-thirds as long as propodus. Auxiliaries about half as long as terminal claw.

Oviger situated in front of the base of first crurigers and with compound spines, each bearing 2 pairs of denticulations, arranged as follows:—12 : 8 : 8 : 8 : : 7.

Chela, a little longer than scape, slightly setose on outer surface and incurved at the base of finger; palm and fingers subequal in length, fingers slender, strongly crossing at tips and armed with about 24–31 denticulations on the immovable finger and about 40 on the movable finger. The number of denticulations in the fingers is larger than the original description indicates, but the remaining characters may prove to be identical.

Previously recorded only from Japan (33°23′ N., 135°34′-37′ E., 544-649 fathoms —Kii Channel; 33°41′ N., 128°50′ E., 75 fathoms—Tusima Strait).

Measurements of a male (in mm)

Length of proboscis	3.5	Fourth leg:	
Length of trunk	8.5	coxa 1	1.5
Width across 2nd crurigers	4.0	coxa 2	4.0
Length of abdomen	1.5	coxa 3	1.8
Length of palp	6.8	femur	11.0
Length of scape	3.5	tibia 1	15.0
Length of chela	5.5	tibia 2	23.0
		tarsus	1.3
		propodus	1.5
		claw	0.5
		auxiliaries	0.25

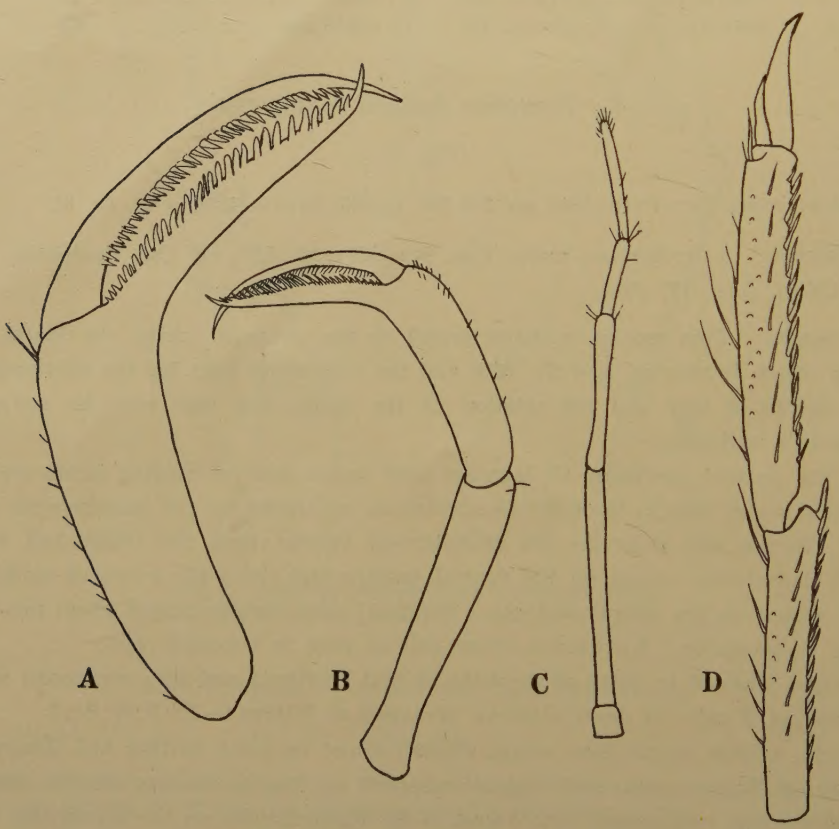

Fig. 3. *Nymphon kodanii* HEDGPETH.
A, chela; B, chelifore; C, palp; D, distal joints of leg.
(B, C, ×11; A, ×21; D, ×33)

5. *Nymphon micropedes* HEDGPETH

(Fig. 4)

Nymphon micropedes HEDGPETH, 1949, pp. 254–256, fig. 24.
N. japonicum KISHIDA (*non* ORTMANN), 1927, p. 990, fig. 1907; OHSHIMA and KISHIDA, 1947, p. 1007, fig. 2857 (reproduced).

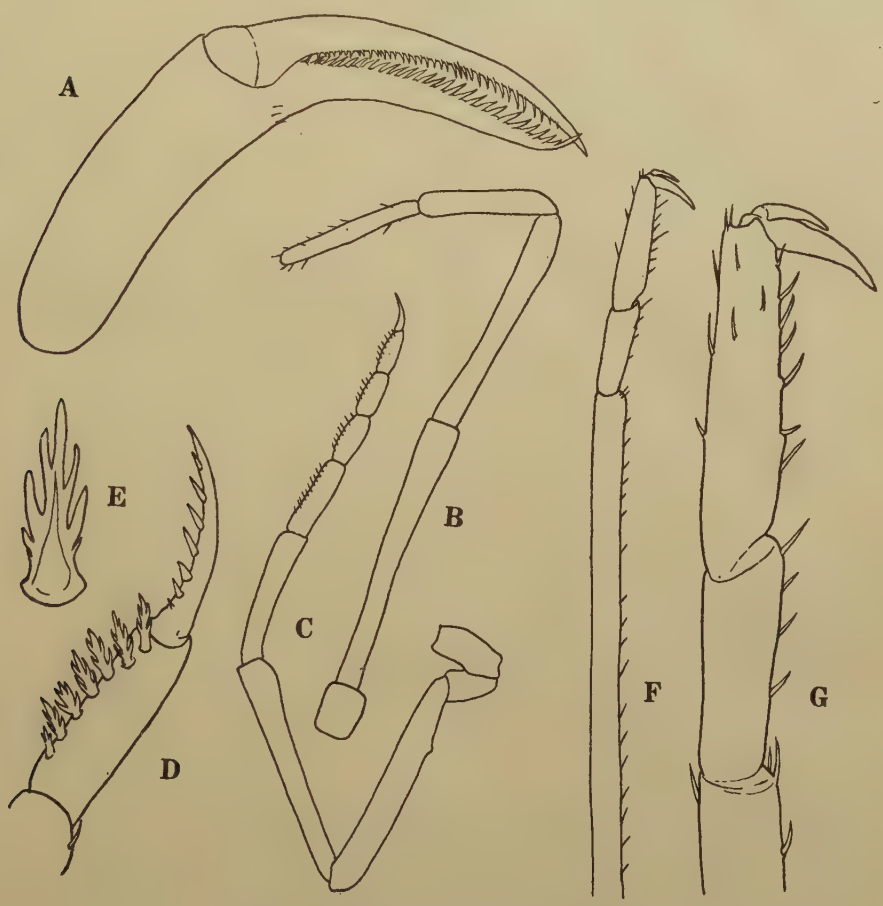

Fig. 4. *Nymphon micropedes* HEDGPETH.
A, chela; B, palp; C, oviger; D, distal joints of oviger; E, compound spine of oviger; F, distal joints of leg; G, tip of the same, enlarged. (C, ×11; F, ×21; A, B, ×27; D, G, ×53; E, ×150)

Material: 3 specimens (Coll. No. 924), St. 645, W. of Tugaru Strait, 115 m. Aug. 22, 1930.

2 specimens (Coll. No. 945), St. 647, W. of Tugaru Strait, 85 m. Aug. 23, 1930.

1 male (Coll. No. 472), St. 658, Tugaru Strait, 113 m. Aug. 30, 1930.

Remarks: All the specimens collected from the Tugaru Strait agree well with HEDGPETH's *N. micropedes*, which is principally characterized by the very short tarsus and propodus and also the large chelae with slender, moderately straight fingers. HEDGPETH denied the presence of eyes, but as illustrated by KISHIDA, they are distinct on a low round ocular tubercle, though not heavily pigmented. He further mentions: "the bases of the ovigers near the anterior end just beyond the origin of the scape." This is undoubtedly not true. In fact, the base of oviger is well separated from the first crurigers and occupies the posterior one-third of the neck behind the anterior cephalic expansion. Spine formula of oviger joints is 10:7:6:7::7.

This species is undoubtedly very close to the preceding species, especially in the shape of chelae and the oviger, the relative length of the joints of legs and the terminal and auxiliary claws. The noteworthy differences between *N. micropedes* and *N. kodanii* are: (1) the chela of *micropedes* has slenderer fingers, longer than palm, (2) the legs in the former are not so setose as in the latter, bearing a row of widely-spaced fine setae on the ventral surface only, (3) the fourth and fifth joints of palp in *micropedes* are subequal, but together shorter than the third, (4) the fifth joint of oviger in *micropedes* is slightly expanded distally.

6. *Nymphon ortmanni* HELFER

(Fig. 5)

Nymphon japonicum LOMAN (*non* ORTMANN, after HELFER 1938), 1911, p. 8 (part).

N. ortmanni HELFER, 1938, pp. 164–167, fig. 1; STOCK, 1953a, pp. 34–36, fig. 1; STOCK, 1954, pp. 20–21, fig. 6d–e.

Material: 1 specimen (Coll. No. 927), St. 653, Tugaru Strait, 108 m. Aug. 24, 1930.

Remarks: This species as redescribed and confirmed by STOCK is characterized by the extremely small auxiliaries and the main claw more than half as long as the propodus. The propodus is slightly longer than the tarsus, as in the type, both bearing thickly set smaller setae on sole and a few longer ones on the other side.

Fig. 5. *Nymphon ortmanni* HELFER.
Distal joints of leg.
(×33)

7. *Nymphon stocki* n. sp.

(Figs. 6 and 7)

Material: 1 specimen (Coll. No. 898—S.M.B.L. Type 157), St. 435, S. of Gotô Islands, 324 m. July 18, 1929.

1 specimen (Coll. No. 905--Paratype), St. 572, N. of Noto Peninsula, 132 m. July 27, 1930.

Description: Trunk moderately slender, completely segmented. Neck of medium length, not greatly expanded at base of chelifores, cephalic segment subequal to the rest of trunk. Oviger implantation lying on each side (not ventrally) well separated from first crurigers, and occupying the posterior one-third of the neck behind the anterior cephalic expansion. Crurigers slightly longer than wide, separated by about

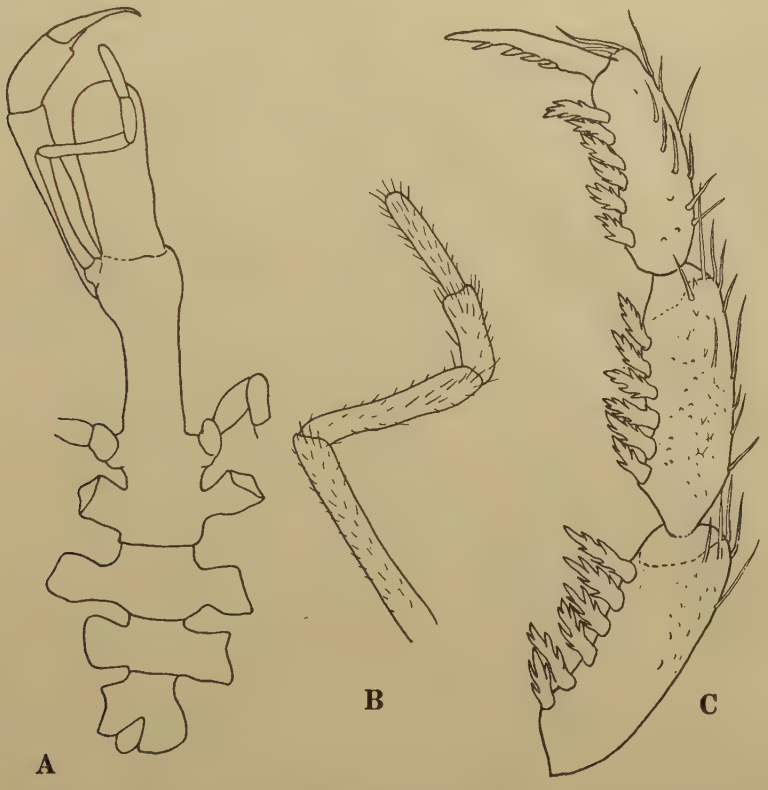

Fig. 6. *Nymphon stocki* n. sp.
A, ventral view of holotype, legs omitted; B, palp; C, distal joints of oviger (from paratype). (A, ×11; B, ×27; C, ×67)

half of their own diameter, their length subequal to median width of segments or less. Proboscis round at tip, nearly cylindrical, about as wide as neck and its length subequal to neck in front of the oviger implantation. Eye tubercle low, rounded at tip, with large eyes not heavily pigmented. Abdomen small, not extending beyond last crurigers, clavate, directed at an angle of about 50°. All surface of body and appendages (proboscis too) wholly covered with peculiar forked hairs.

Chelifore with scape as long as proboscis; chelae about as long as scape, with

short fingers. Fingers about as long as palm, armed with 17–21 large well-separated teeth on immovable finger and 20–31 on dactylus. Scape and palm heavily setose and hairy; fingers glabrous.

Palp slender, setose throughout, second joint about two-thirds as long as proboscis, third joint a trifle shorter than second, fourth joint shorter than fifth; the distal two joints together longer than third.

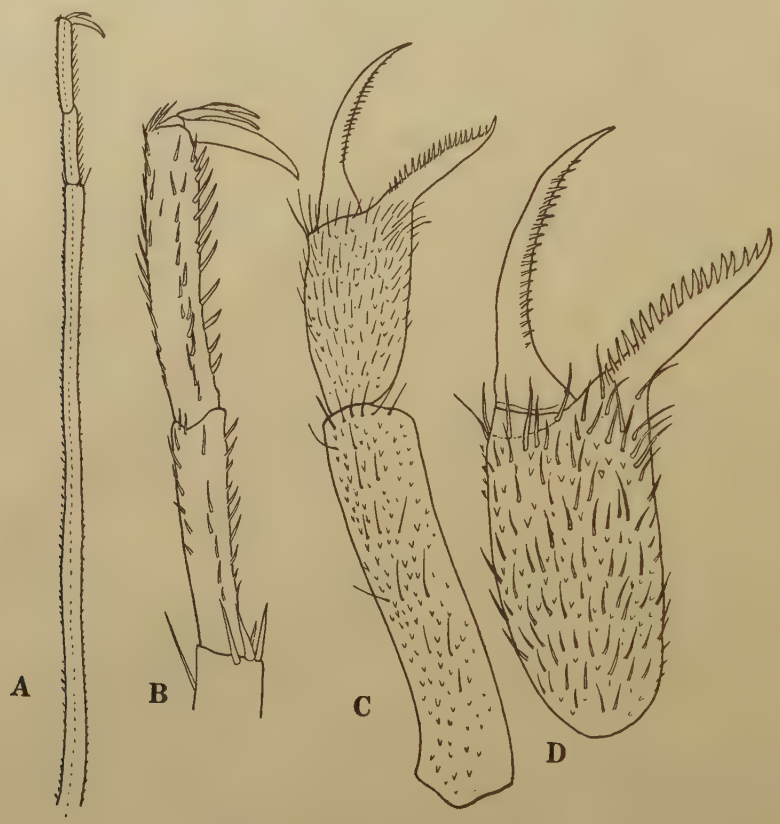

Fig. 7. *Nymphon stocki* n. sp.
A, distal joints of leg; B, tip of the same, enlarged; C, chelifore; D, chela, (A, ×11; C, ×21; B, D, ×33)

Oviger 10-jointed, moderately slender; first joint very short, second and third about equal and a little longer than first. Distal 4 joints hairy, armed with stiff setae on the outer side and a row of compound spines with pairs of 2–3 denticulations on the inner side. Terminal claw fairly straight, about three-fourths as long as the last joint, and armed with 4 well-spaced spines. Spine formula in the holotype is ?:8:6:5::4, while in the paratype 10:6:6:6::4.

Legs heavily setose, being armed with 4 longitudinal rows of short setae from

tibiae to propodus, besides forked hairs scattered. It is to be regretted that there has been found no perfect leg with all joints. But, tibia 2 is extremely long and slender, approximately seven times as long as the sum of tarsus and propodus. Propodus slightly longer than tarsus and armed with 12–13 subequal setae on sole which are somewhat larger than those of lateral and dorsal rows. Terminal claw slightly curved, a little shorter than half of propodus and less than twice as long as auxiliaries.

Measurements of the holotype (in mm)

Length of proboscis	2.0	coxa 3	2.5
Length of trunk	5.0	femur	7.0
Length of abdomen	0.8	tibia 1	8.5
Length of chelfore	4.0	tibia 2	15.0
Length of 2nd cruriger	1.0	tarsus	0.8
A leg detached from body:		propodus	1.3
coxa 1	0.8	claw	0.6
coxa 2	1.0	auxiliaries	0.34

Remarks: This species somewhat resembles *Nymphon benthos* HEDGPETH (1949) from Japanese waters, *N. pixellae* SCOTT (=*N. solitarium* EXLINE) from Pacific coast of North America (HILTON, 1942) and *N. arabicum* CALMAN (1938) from South Arabian coast in the general feature. It is, however, different from them, in particular by the well-separated oviger implantation from the first crurigers, the shorter chelae, the shorter crurigers and abdomen, the longer auxiliary claws and the peculiar hairy investiture covering the body and appendages.

This interesting new species is named for Dr. J. H. STOCK, of the Zoological Museum, Amsterdam, in recognition of his excellent contribution to the study of Japanese pycnogonids based on Dr. Th. MORTENSEN's collection.

8. *Nymphon soyoi* n. sp.

(Fig. 8)

Material: 1 female (Coll. No. ?—S.M.B.L. Type 158), St. 558, W. of Noto Peninsula, 188 m. July 22, 1930.

Description: Trunk moderately stout, anterior end broadly expanded at chelifore bases. Neck short, about half as wide as anterior cephalic expansion, distinctly constricted in front of base of ovigers lying ventrally. Crurigers about twice as long as wide, separated by less than their own diameter. Eye tubercle higher than wide, slightly pointed at tip, eyes distinct.

Proboscis stout, truncate at end, expanded about halfway; its length nearly equal to that of cephalic segment in front of eye tubercle and its diameter distinctly larger than that of neck. Abdomen distinctly longer than last crurigers, clavate and nearly horizontal. Glabrous.

Chelifore: scape joints missing. Chela long, slender, with curved fingers, deeply

crossing at tip. Fingers longer than palm, armed with 20–21 large teeth on immovable finger and 30 slender teeth on movable finger.

Palp long, slender, second joint a little shorter than proboscis, third joint less than half as long as second; fourth and fifth joints subequal, the two together about two-thirds as long as second. Terminal joints armed with fine setae.

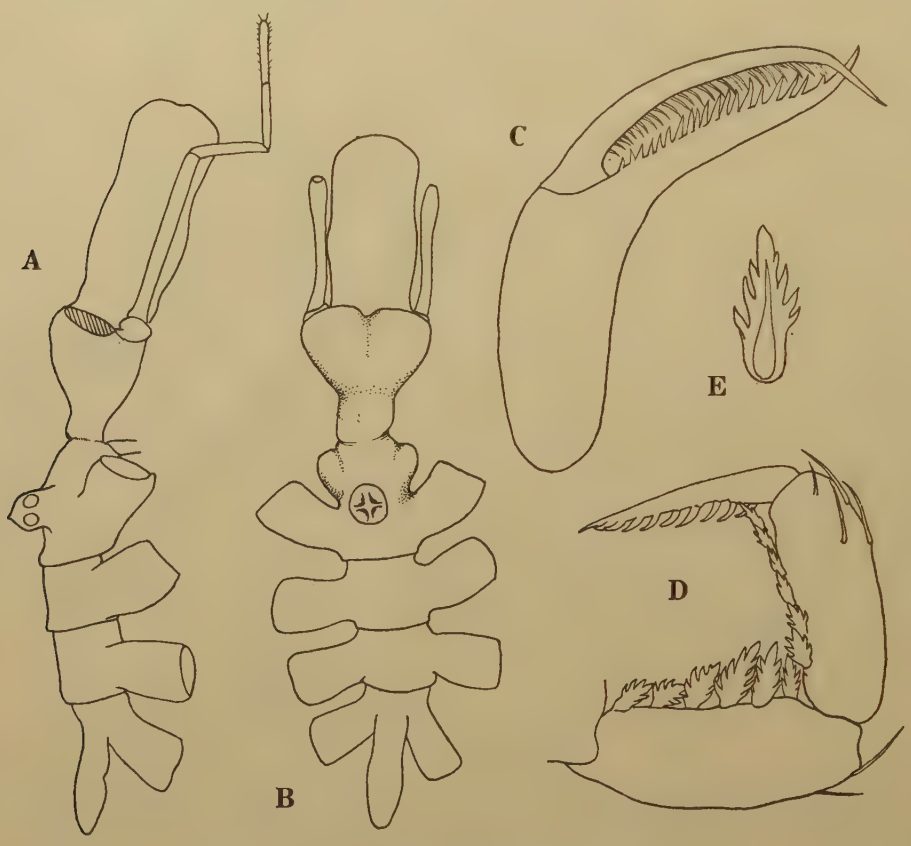

Fig. 8. *Nymphon soyoi* n. sp.
A, lateral view of female holotype, legs omitted; B, dorsal view of trunk; C, chela; D, distal joints of oviger; E, compound spine of oviger. (A, B, ×11; C, ×27; D, ×33; E, ×150)

Oviger with subequal distal joints, each bearing a few setae on outer surface and compound spines with 2–4 pairs of coarse denticulations on inner surface. Spine formula is 8:7:6:6::9. Terminal claw straight, with 7 recurved spines on inner margin.

Legs cannot be accurately observed, all joints being detached off. Distal joints including claws missing.

Measurements of the holotype (in mm)

Length of proboscis	2.6	Legs:	
Diameter of proboscis	1.0	coxa 1	1.0
Length of trunk	4.3	coxa 2	2.5
Width across 2nd crurigers	2.6	coxa 3	1.5
Length of abdomen	1.3	femur	6.5
Length of chela in situ	3.3	tibia 1	10.0
Length of palm	1.8	tibia 2	12.0
Length of finger	2.0		

Remarks: Although the specimen is not complete, lacking the distal joints of legs, this species cannot be referred to any known species of the genus *Nymphon* in respect to the distinct constriction in the neck and the combination of other characters described above.

9. *Nymphon falcatum* n. sp.

(Fig. 9)

Material: 1 female (Coll. No. 896—S.M.B.L. Holotype 159) and 3, including ovigerous male and female (Coll. No. 896—S.M.B.L. Paratypes), St. 315, off Mimitu, Miyazaki Pref., 421 m. July 15, 1928.

Description: Trunk extremely slender, elongate, distinctly segmented. Crurigers also very slender, elongate, widely separated by two or three times of their own diameter; its length about thrice of its own diameter in the first to third crurigers, while about twice in the last one. Cephalic segment about three-fourths as long as the sum of the three posterior segments; neck long, slender, at base of chelifores greatly enlarged. Base of oviger in contact with first crurigers. Eye tubercle low, rounded at tip, situated on trunk at the base of first crurigers; eyes small but distinct. Proboscis rather heavy, rounded at tip, shorter but wider than neck. Abdomen clavate, long, about 1.5 times as long as the last crurigers. Setae apparently absent.

Chelifore: scape directed outwards at an angle of 50°, much longer than proboscis. Chela strongly curved inwards, slender, much longer than scape and articulating in situ with scape at an angle of about 110°. Fingers slender, about 1.5 times as long as palm, armed with small teeth which are the longest in the middle, 28 on immovable finger and 18–20 on movable finger.

Palp slender, about 6 mm long in the holotype, second joint the longest, its end reaching the anterior end of proboscis. Fourth joint slightly shorter than second; third and fifth joints subequal and slightly shorter than fourth. Distal two joints hairy.

Oviger 10-jointed, fourth joint more than twice as long as third, slightly curved, with a slight projection at the proximal third on the outer side, fifth joint nearly

straight, a little longer than fourth, slightly expanded distally.[1] Compound spines of terminal joints very minute, with 2 or 3 pairs of denticulations. Spine formula in seventh to ninth joints is 4 : 4 : 3, distal ones being missing.[2]

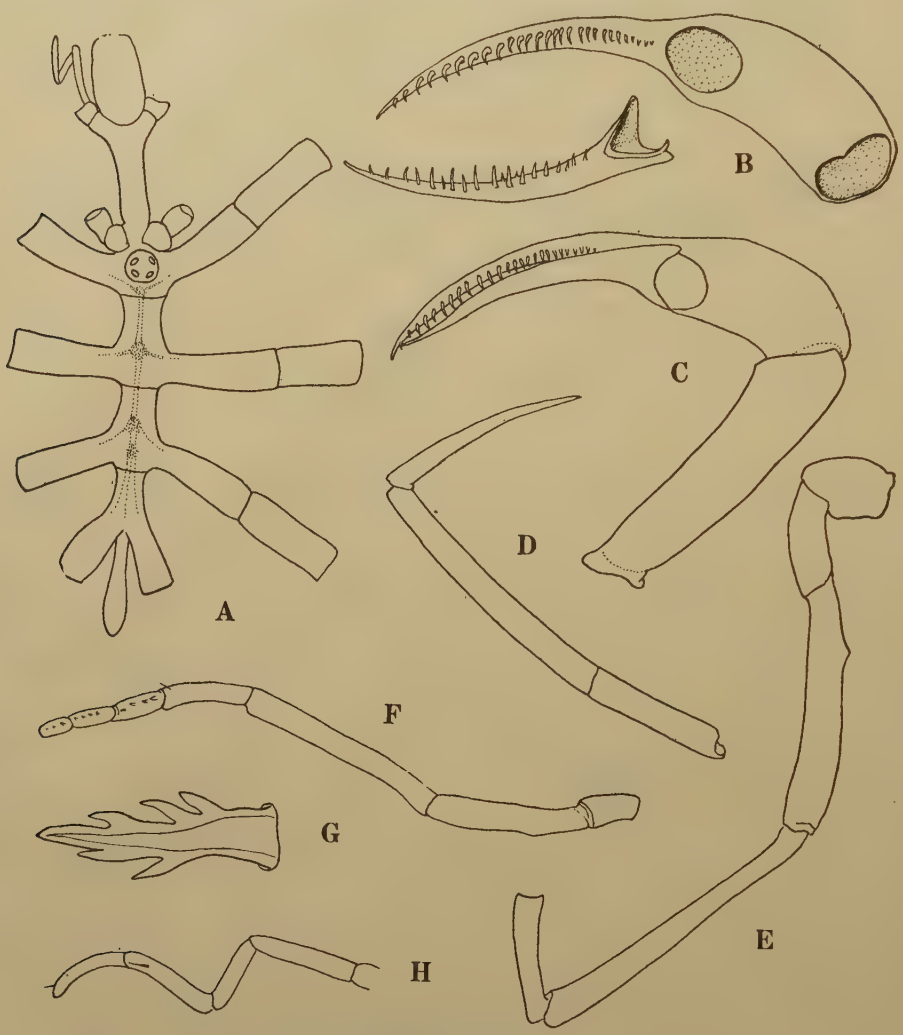

Fig. 9. *Nymphon falcatum* n. sp.
A, dorsal view of female holotype, legs omitted; B, chela; C, chelifore; D, distal joints of leg; E, proximal joints of male oviger; F, female oviger, terminal joint and claw missing; G, compound spine of female oviger; H, palp.
(A, ×11; C-F, H, ×21; B, ×33; G, ×413)

1) According to STOCK's personal communication (Apr. 14, 1955), the 5th joint of a male oviger is extremely long, about twice as long as the 4th, and furnished with a distal apophysis, which may be a characteristic of this species.
2) According to STOCK, spine formula in a male oviger in his material is 5 : 4 : 4 : 5 :: 6.

Legs long, slender, apparently glabrous. Coxa 1 and 3 subequal, about twice as long as wide. Tibia 2 the longest, nearly as long as the sum of femur and tibia. Tarsus the shortest, slightly longer than half of propodus. Propodus also slender and straight, without setae. Terminal claw shorter than propodus, and longer than tarsus, slightly curved, falciform. No auxiliaries.

Measurements of four specimens (in mm)

	Holotype	Paratype A	Paratype B	Paratype C
Length of proboscis	1.0	1.5	1.0	1.3
Length of neck	1.0	1.35	1.4	1.0
Length of trunk (excluding neck portion)	2.9	3.8	3.5	3.0
Length of abdomen	0.9	1.2	1.2	1.2
Interval between 1st and 2nd crurigers	0.6	0.7	0.8	0.6
Length of 2nd cruriger	0.8	1.2	1.2	0.9
Width of trunk between 1st and 2nd crurigers	0.3	0.45	0.4	0.35
Third leg:				
Coxa 1	1.2	1.0		
Coxa 2	2.0	1.5		
Coxa 3	0.9	0.8		
Femur	3.3	3.3		
Tibia 1	4.5	4.5		
Tibia 2	10.0	7.8		
Tarsus	0.8			
Propodus	1.7			
Claw	1.35			

Remarks: This species is most closely allied to *Nymphon hedgpethi* STOCK (1955 b) from Albatross Station 5348 (NW. of Palawan Island, Philippines, 375 fathoms) in the considerable slenderness of the trunk, the short proboscis and the large chelifores. It differs, however, from *N. hedgpethi* and its allies (such as *N. profundum* HILTON, *N. hamatum* HOEK, etc.) in the presence of eye tubercle, the absence of distal setae on the crurigers, and the relative length of the distal joints of legs.

The trivial name (*falcatum*) here proposed refers to the shape of the terminal claw of the legs.

Dr. J. H. STOCK has kindly informed me that an apparently similar form to this proposed new species is included in the collection of Dr. Th. MORTENSEN's Pacific Expedition, though not described as yet in his first paper dealt with the pycnogonids from the Indo-West Pacific region. The locality where his specimen was obtained is, according to him, 33°41′ N., 128°50′ E. (Tusima Strait), 75 fathoms.

Family CALLIPALLENIDAE HILTON
(= Pallenidae auct.)

Genus *Parapallene* CARPENTER

11. *Parapallene nierstraszi* LOMAN

(Fig. 10)

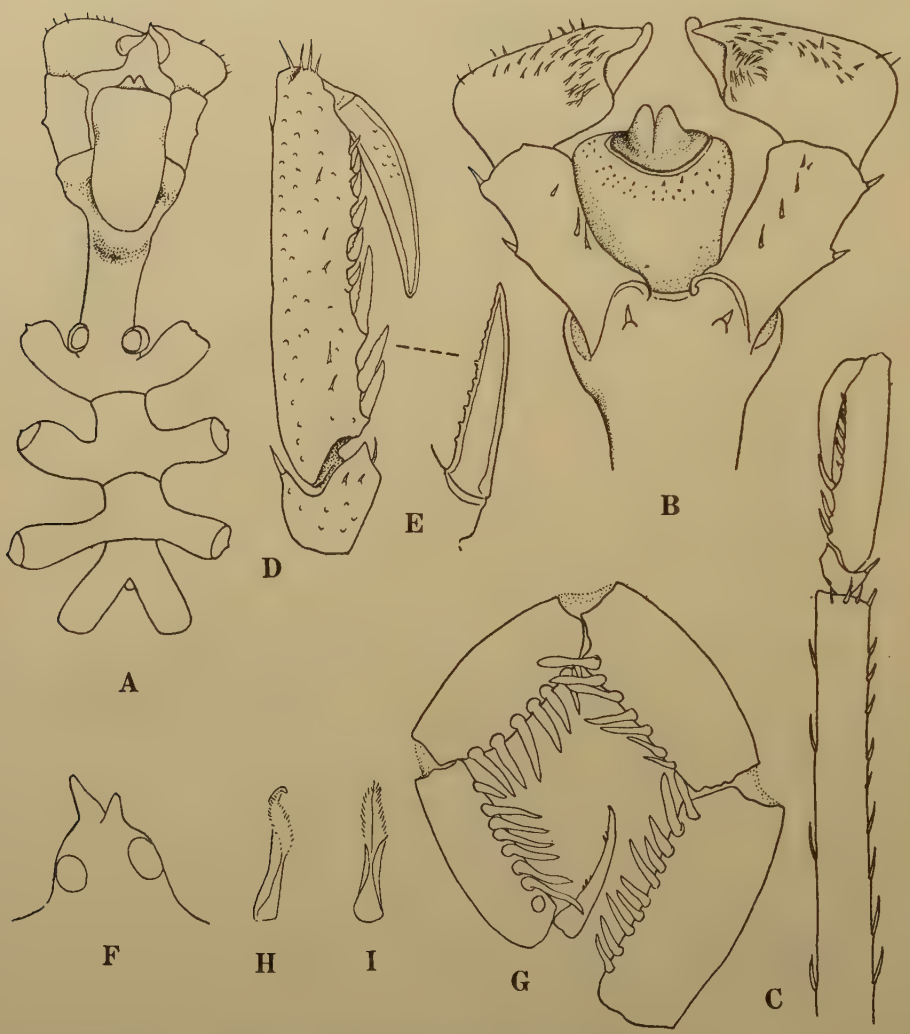

Fig. 10. *Parapallene nierstraszi* LOMAN.
A, ventral view of trunk, legs omitted; B, dorsal view of the anterior part of body; C, distal joints of leg; D, end of leg; E, propodal spine; F, eye tubercle, seen from behind; G, distal joints of oviger; H–I, oviger spines. (A, ×11; C, ×18; B, ×21; D, F, ×33; G, ×53; E, ×97; H, I, ×150)

Parapallene nierstraszi LOMAN, 1908, pp. 44–45, Pl. IX figs. 122–127; FLYNN, 1928, p. 18; CALMAN, 1938, pp. 158–159, fig. 7; BARNARD, 1954, p. 113; STOCK, 1954, p. 52, fig. 24f.

Material: 1 female (Coll. No. 899), St. 468, E. of Tusima, Tusima Strait, 112 m. July 25, 1928.

Remarks: The present material agrees in all essentials with LOMAN's type, but the neck is not so elongately slender and lacks the constriction in front of the oviger implantation.

The setation on the scape of chelifores and its base is noticeable as indicated in Fig. 10B; this feature is not met with in previous descriptions. The spination of the crurigers and legs is not marked, only bearing a slight conical elevation on the dorso-distal end of crurigers and coxa 1.

The eye tubercle is bifurcated at tip, with two asymmetrical conical processes. The proboscis is narrowed in the middle and provided at the tip with a large mouth and two distinct oral lips.

Up to now, this species was not recorded from Japanese waters.

Measurements of a female (in mm)

Length of proboscis	1.2	A leg:	
Diameter of proboscis	0.88	coxa 1	0.9
Length of trunk	3.8	coxa 2	2.4
Width of trunk (excluding crurigers)	0.6	coxa 3	1.0
Length of crurigers	1.0	femur	5.6
Length of scape	1.2	tibia 1	6.0
Length of chela	1.2	tibia 2	10.0
		tarsus	0.4
		propodus	1.6
		claw	0.76

Genus *Pallenopsis* WILSON

12. *Pallenopsis sibogae* LOMAN

(Fig. 11)

Pallenopsis plumipes LOMAN (*non* MEINERT) 1908, pp. 66–67, Pl. XII figs. 160–164.
P. sibogae LOMAN, 1911, p. 14; STOCK, 1954, pp. 63–64, fig. 30 h-i.

Material: 1 male (Coll. No. 340), St. 278, Suruga Bay, 79 m. July 2, 1928.

Remarks: This is a second record of the species from Japan. Hitherto records in the East Indian waters are from Kwandang Bay, North Celebes and from Jolo, Philippines, and in Japan from west of Kyusyu.

As was noticed by STOCK, the male is more hairy than the female, the legs being provided with feathered long setae grouped together distally or medially. Tibia 2 is the longest of all joints, slender and bears fairly simple setae all throughout. A long, tube-like duct of cement gland exists in the middle of the ventral surface of

the femur. The distal end of both the femur and tibia 1 is not so markedly protruded as in the female (figured by LOMAN). Propodus is long and only slightly curved, though not so strongly as STOCK indicates. Genital pores situated on a low distal spur of coxa 2 in the posterior 2 pairs of legs.

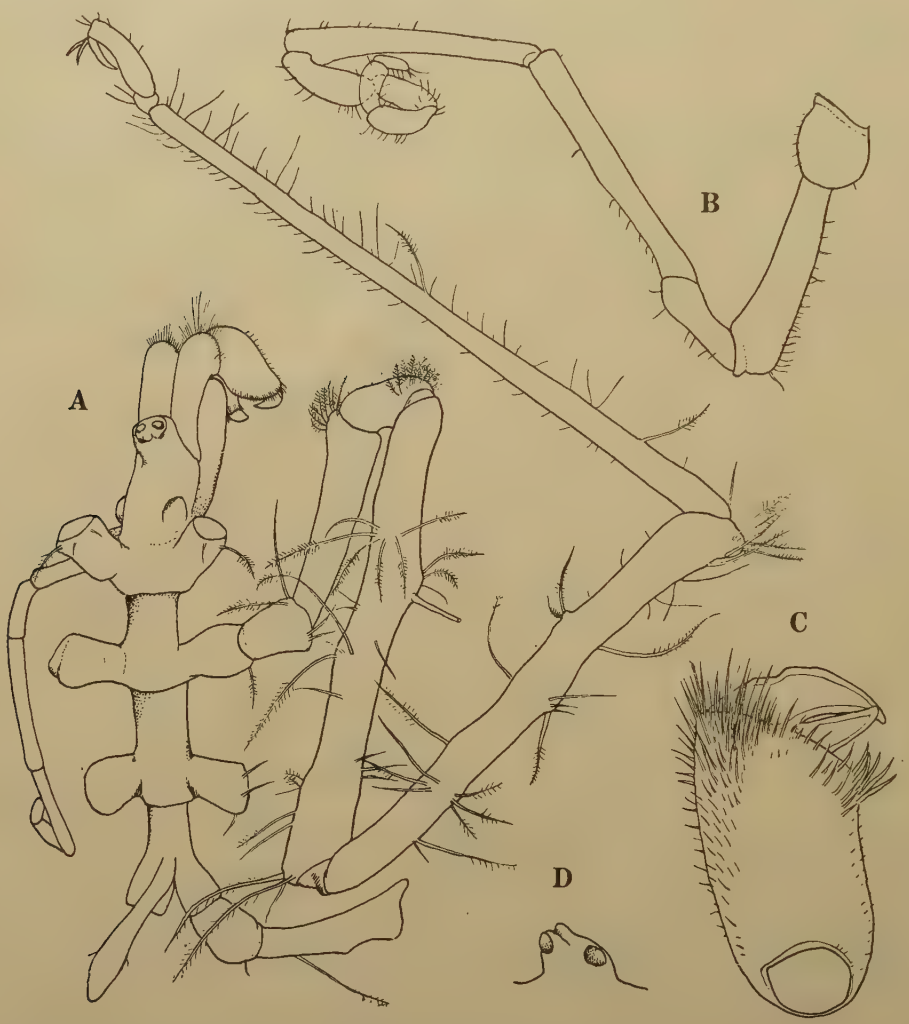

Fig. 11. *Pallenopsis sibogae* LOMAN.
A, dorsal view of trunk, showing 2nd leg on the right side and an oviger on the left; B, male oviger; C, chela; D, eye tubercle, seen from the right. (A, ×11; B, ×21; C, ×67)

The eye tubercle seems to be characteristic. It is wider than high and tipped with two small processes posteriorly; the anterior eyes are distinctly larger than the posterior pair situated on the outer side of processes.

Measurements of a male (in mm)

Length of proboscis	2.0	Fourth leg :	
Length of trunk	6.0	coxa 1	0.6
Length of abdomen	2.0	coxa 3	2.5
Length of crurigers	0.8	femur	5.5
Length of scape	1.5	tibia 1	6.0
Length of chela	1.2	tibia 2	8.0
		tarsus	0.3
		propodus	1.2
		claw	0.6
		auxiliaries	0.4

Family PHOXICHILIDIIDAE G. O. Sars

As I have already criticized, the generic distinction between the genera *Phoxichilidium*, *Anoplodactylus* and *Halosoma* is almost untenable. But I have stated that a combination of morphological characters and habitats (as to whether living in shallow or deep waters) would become the separation of this troublesome group more natural (Utinomi, 1954).

The hitherto generally admitted generic characters for separating *Anoplodactylus* from *Phoxichilidium* are diversified among taxonomists. Such characters as the forward-extending cephalic segment and the reduction or absence of auxiliary claws, by which most of the earlier authors assigned to, are not definitely recognized in some of the species of *Anoplodactylus* to which they are assigned. The same may be said also for the relation between the number of oviger joints and the development of auxiliary claws. And the two above-mentioned characters are not always combined together in each of the species.

Another reliable criterion which I have suggested is the relative length between the second and third joints of the oviger. This character seems to be combined with the contour of body (robust or slender) as well as the habitat to a certain degree. In other respects, however, it is not true. All attempts to define the two or three genera, mainly based on the relative length of different joints and claws, fail, as the number of new species increases in the future.

After long consideration, now I arrived at a conclusion that it would be highly natural to keep them all in one genus to avoid further confusion. Indeed, Dr. Joel W. Hedgpeth says that "It may not be long before some bold person decided to lump them together" (Personal communication!). If dividing and re-grouping of this family is to be retained as a matter of convenience, a further and more detailed search for other distinctive characters (e.g. the papillae-bearing proboscis, the propodal cutting lamina, the arrangement of femoral cement glands, etc.), which have been regarded only as of specific importance, should be needed.

Genus *Phoxichilidium* H. MILNE-EDWARDS (Including *Anoplodactylus* and *Halosoma*)

13. *Phoxichilidium ungellatum* HEDGPETH

(Fig. 12)

Phoxichilidium ungellatum HEDGPETH, 1949, pp. 281–283, fig. 38; STOCK, 1954, p. 71.

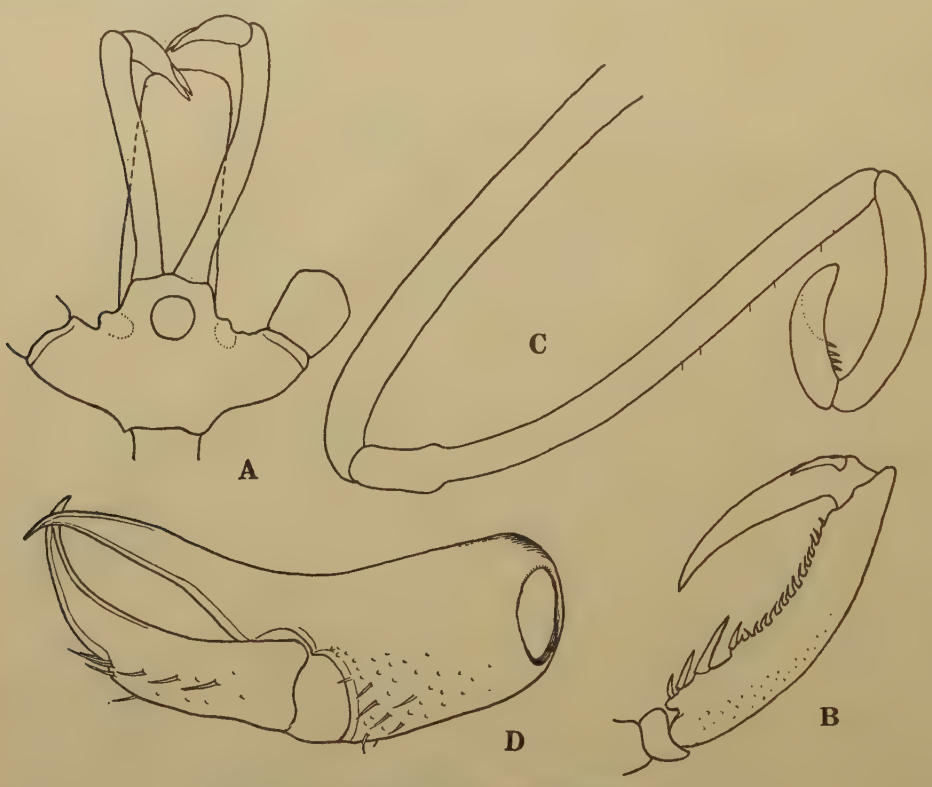

Fig. 12. *Phoxichilidium ungellatum* HEDGPETH.
A, dorsal view of cephalic segment; B, tarsus and propodus; C, male oviger; D, chela. (A, ×11; B, C, ×21; D, ×67)

Material: 1 female (Coll. No. 876), St. 22, off Sioya-zaki, Hukusima Pref., 539 m. June 29, 1926.

1 male (Coll. No. 878), St. 36, off Kinkazan, Miyagi Pref., 309 m. July 4, 1926.

1 male (Coll. No. 913), St. 591, off Teradomari, Niigata Pref., 311 m. Aug. 3, 1930.

Remarks: This species is rather slender, with a less-prolonged cephalic segment and bears a long, 5-jointed oviger, of which the third joint, with a hint of segmentation near the base, is longer than the second (but not twice of the latter). The

most remarkable characteristic is the chelae which are armed with a tuft of setae midway on the outer surface of the dactylus. A trace of palp is present as low conical knobs at the base of the first crurigers; this has been overlooked by HEDGPETH.

Previously recorded only from Japanese waters, with a wide bathymetrical range (82–587 fathoms).

Family AMMOTHEIDAE DOHRN

Genus *Achelia* HODGE

14. *Achelia superba* (LOMAN)

(Fig. 13)

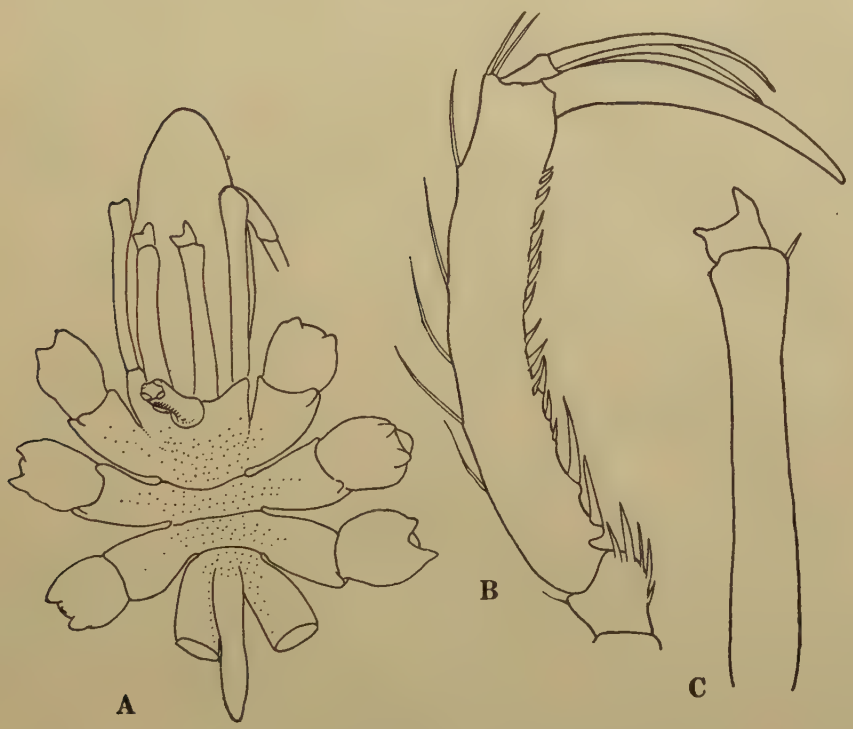

Fig. 13. *Achelia superba* (LOMAN).
A, dorsal view of trunk; B, tarsus and propodus; C, chelifore.
(A, ×21; B, C, ×67)

Ammothea superba LOMAN, 1911, pp. 11–12, Pl. I figs. 14–15, Pl. II figs. 16–24; KISHIDA, 1927, p. 989, fig. 1906; OHSHIMA, 1936, p. 866 (listed); OHSHIMA and KISHIDA, 1947, p. 1008, fig. 2860.

Achelia superba HEDGPETH, 1949, p. 287; UTINOMI, 1951, pp. 160–161; STOCK, 1954, p. 96.

Material: 1 male (Coll. No. 900), St. 376, SW. of Omaé-zaki, Sizuoka Pref., 64 m. Aug. 13, 1928.

Remarks: This species is characterized by the long scape of chelifores, the long eye tubercle and the long abdomen. The body and legs are finely granulate. The third and fourth segments of the trunk are distinctly demarcated in the present material, instead of being fused in previous descriptions.

As all previous collecting records indicate, this species is not a real shore form.

Genus *Ascorhynchus* G. O. SARS

15. *Ascorhynchus japonicum* IVES

Ascorhynchus japonicus IVES, 1892, pp. 219–221, Pl. XI figs. 4–10; LOMAN, 1911, p. 5; OHSHIMA and KISHIDA, 1947, p. 1008, fig. 2859; HEDGPETH, 1949, pp. 292–293; UTINOMI, 1951, p. 166; HEDGPETH, 1954.
A. japonicum STOCK, 1954, pp. 126–128, figs. 61–62.

Material: 1 male (Coll. No. 497), St. 383, off Owase, Mie Pref., 353 m. Dec. 4, 1927.

Remarks: The specimen is damaged, but it measures nearly 10 mm long in trunk, 7 mm long in proboscis and 3.5 mm long in abdomen.

16. *Ascorhynchus cryptopygium* ORTMANN

(Fig. 14)

Ascorhynchus cryptopygius ORTMANN, 1891, pp. 159–160, Pl. 24 fig. 2; LOMAN, 1911, p. 7; OHSHIMA, 1936, p. 865 (listed).
A. cryptopygium STOCK, 1954, p. 121, fig. 58.

Material: 1 specimen (Coll. No. 888), St. 236, off Suno-saki, Sagami Bay, 251 m. Nov. 6, 1927.

Remarks: Most of the legs and ovigers are lost, so the sex of the specimen cannot be determined. Previous records are all from Sagami Bay in 60–150 fathoms.

This less-known species is characterized by the unusually very small abdomen directed ventrally, so that it is hardly visible from above. Proboscis is 4.5 mm long and trunk 5.5 mm long, while the abdomen is only 0.6 mm long.

Chelifore: Scape 1-jointed, with a trace of chela.

Palp probably 8-jointed; distal 4 joints finely setose and the sum shorter than the preceding joint.

Oviger implantation situated on each side between the base of eye tubercle and the base of first crurigers as a low mound.

Crurigers separated by about their own diameter, each with a small tubercle at dorso-distal end.

Of the legs, tarsus is less than half as long as propodus; claw slightly arched, falciform and nearly twice of the length of propodus.

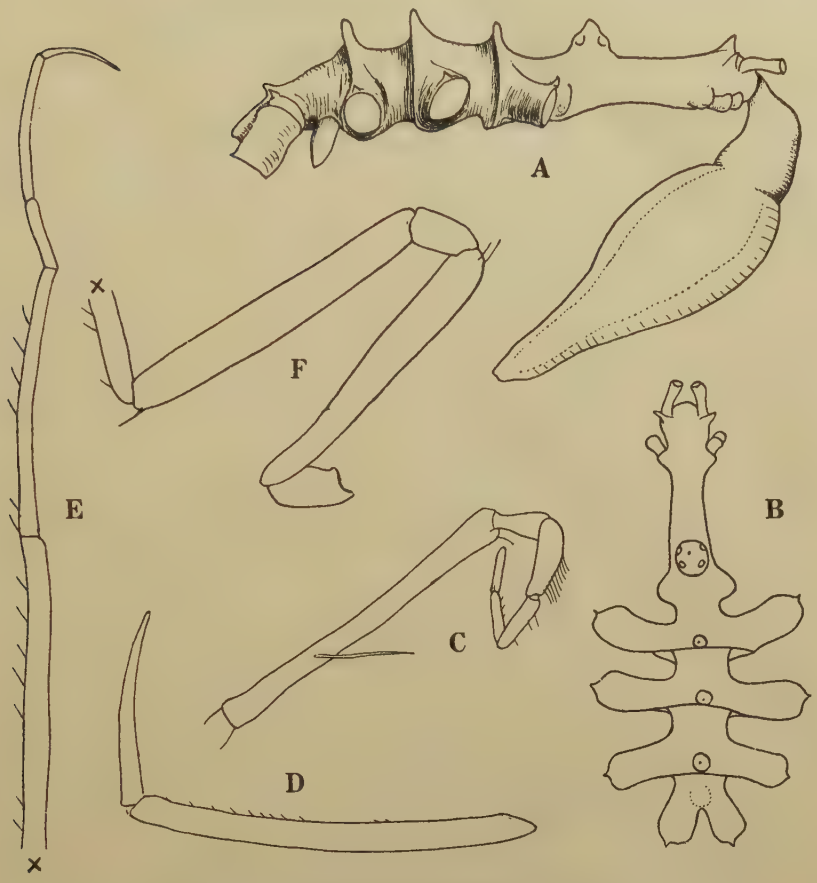

Fig. 14. *Ascorhynchus cryptopygium* ORTMANN.
A, lateral view of trunk and proboscis, legs omitted; B, dorsal view of trunk, legs omitted; C, distal joints of palp; D, propodus and claw; E–F, fourth leg. (A, B, E, F, ×11; C, D, ×33)

17. *Ascorhynchus glabroides* ORTMANN

Ascorhynchus glabroides ORTMANN, 1891, pp. 160–161, Pl. 24 fig. 3a–b; OHSHIMA, 1936, p. 865 (listed), HEDGPETH, 1949, p. 293; UTINOMI, 1951, p. 166.
A. glabrioides LOMAN, 1911, p. 7.

Material: 1 specimen (Coll. No. 365), St. 293, off Sata-misaki, Kagosima Pref., 203 m. July 10, 1928.

Remarks: This species seems to be common in deep waters around Japan with the bathymetrical range of 72–250 m.

18. *Ascorhynchus glaberrimum* SCHIMKEWITSCH

(Fig. 15)

Ascorhynchus glaberrimus SCHIMKEWITSCH, 1913, pp. 242–244, Pl. 3a figs. 8–14; ——, 1929, pp. 107–110, figs. 23–25; OHSHIMA, 1936, p. 865 (listed); HEDGPETH, 1949, p. 293.

Material: 1 female (Coll. No. 904), St. 485, E. of Misima, Yamaguti Pref., 93 m. Aug. 11, 1929.

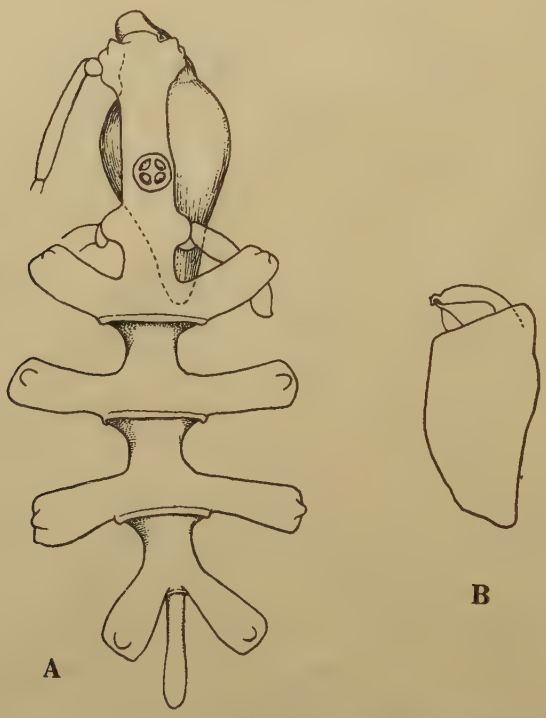

Fig. 15. *Ascorhynchus glaberrimum* SCHIMKEWITSCH.
A, dorsal view of trunk, legs omitted; B, chelifore.
(A, ×11; B, ×33)

Remarks: This specimen seems to be identified with *A. glaberrimum* which is so far recorded only by the Russian author from the vicinity of Nagasaki. HEDGPETH's brief note is probably based only on this SCHIMKEWITCH's data, not on the Albatross collection.

Although the specimen is imperfect, it measures about 4 mm long in proboscis, 8.5 mm long in trunk and 1.5 mm long in abdomen.

This little known species is distinguishable from the others by the naked dorsum of the trunk, the presence of a slight tubercle at the distal end of crurigers and the chelifore consisting of 1-jointed small scape and perfectly chelate chela.

Genus *Cilunculus* Loman

19. *Cilunculus armatus* (Böhm)

(Fig. 16)

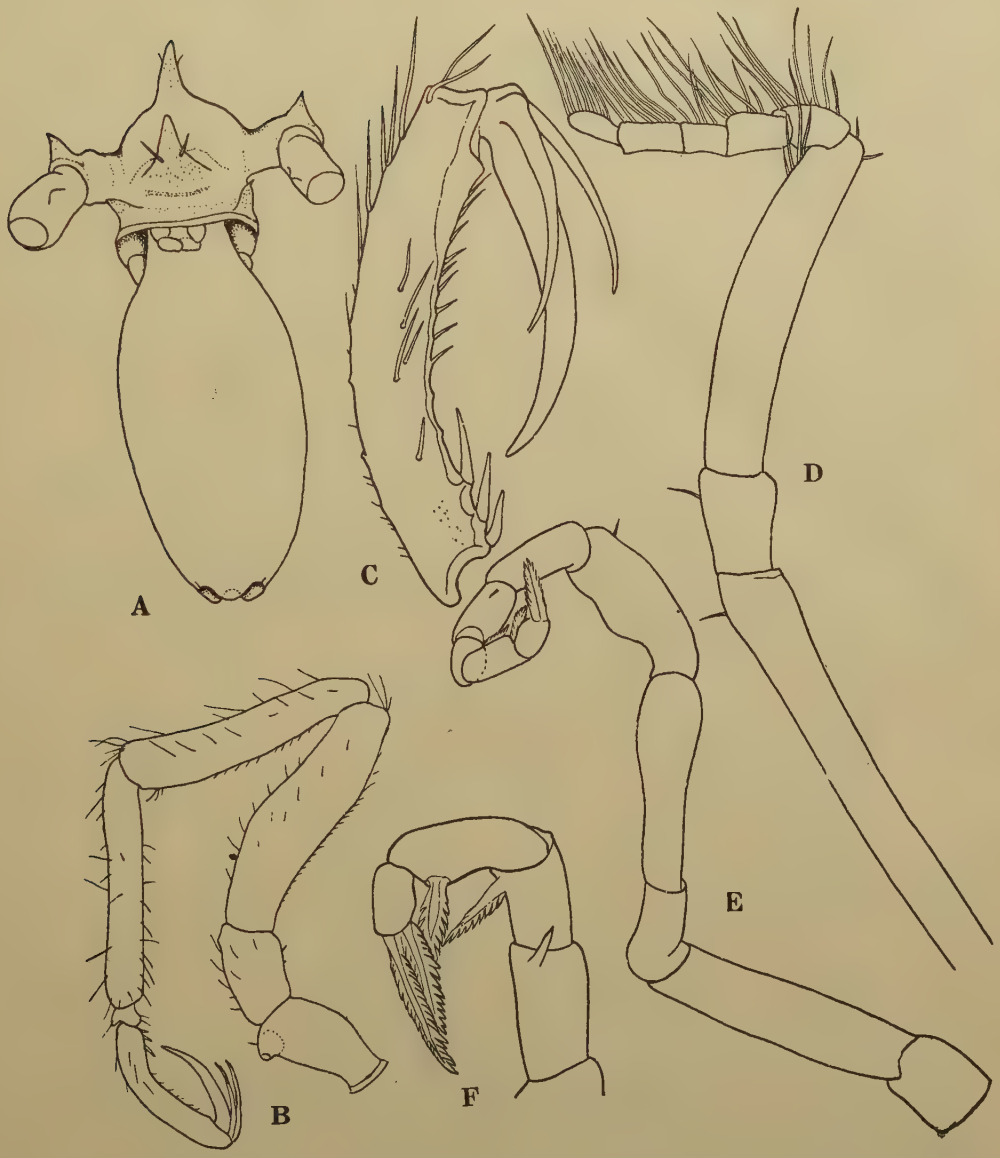

Fig. 16. *Cilunculus armatus* (Böhm).
A, frontal view of trunk; B, fourth leg of female; C, propodus; D, palp; E, female oviger; F, distal joints of female oviger. (A, B, ×18; C–E, ×53; F, ×97)

Lecythorhynchus armatus BÖHM, 1879, pp. 141–142.
Parazetes pubescens ORTMANN, 1891, pp. 163–164, Pl. 24 fig. 5a–d.
Cilunculus armatus LOMAN, 1911, pp. 9–11, Pl. I figs. 1–8; OHSHIMA, 1936, p. 866 (listed); HEDGPETH, 1949, p. 294, fig. 43.
Cilungulus armatus SCHIMKEWITSCH, 1929, p. LXXVI, fig. 5A–C, pp. 81–88, figs. 18, 19A–C, 20.

Material: 1 female (Coll. No. 888), St. 236, off Sunosaki, Sagami Bay, 251 m. Nov. 6, 1927.

Remarks: The present female specimen resembles LOMAN's drawing of the male rather than HEDGPETH's drawing of the female, in respect to the spinous processes and tubercles on the trunk and lateral processes. The ocular tubercle is provided with 2 setae instead of eyes and the dorsal tubercles, each on one segment of the trunk, are very prominent, though decreasing their size backwards. A similar but smaller tubecle (never 3 or more as in HEDGPETH's figure) is situated at the distal end of the lateral processes. These tubercles, together with a pair of frontal processes at the base of palp, are granulate on surface.

Proboscis profoundly plump, egg-shaped, distinctly notched on the ventral side of the frontal edge and directed vertically downwards.

Chelifore 2–jointed, almost naked; chela not chelate, directed inward.

Palp prominently developed, 9–jointed, distal joints densely setose.

Oviger 10–jointed. Joint 7 with a simple spine. Joint 8 and 9 with a compound spine, and joint 10 with 2 compound spines.

Legs rather setose. Coxa 2 protruded distally, where a genital pore is situated in the last pair of legs. Femur, tibia 1 and tibia 2 are subequal. Tarsus quite small. Propodus slender, curved, with 3 strong spines on sole. Claw strong, about two-thirds as long as propodus, auxiliaries also strong.

Measurements of a female (in mm)

Length of proboscis	2.5	coxa 3	0.8
Length of trunk	2.0	femur	2.0
Length of abdomen	1.3	tibia 1	1.9
Length of oviger	2.3	tibia 2	1.9
Diameter of proboscis	1.3	tarsus	0.2
Fourth leg:		propodus	1.2
coxa 1	0.8	claw	0.8
coxa 2	1.0	auxiliaries	0.5

Genus *Heterofragilia* HEDGPETH

20. *Heterofragilia amica* STOCK

(Figs. 17 and 18)

Heterofragilia amica STOCK, 1954, pp. 136–139, figs. 67–68.

Material: 1 specimen (Coll. No. 365), St. 293, off Sata-misaki, Kagosima Pref., 203 m. July 10, 1928.

Remarks: This curious pycnogonid agrees in general with STOCK's *Heterofragilia amica* taken from the SW. of Gotô Islands (32°15′ N., 128°12′ E., 90 fathoms), not far from the locality where this was obtained. Some slight disagreements are observed between the two, but they seem to me to be unimportant for specific separation.

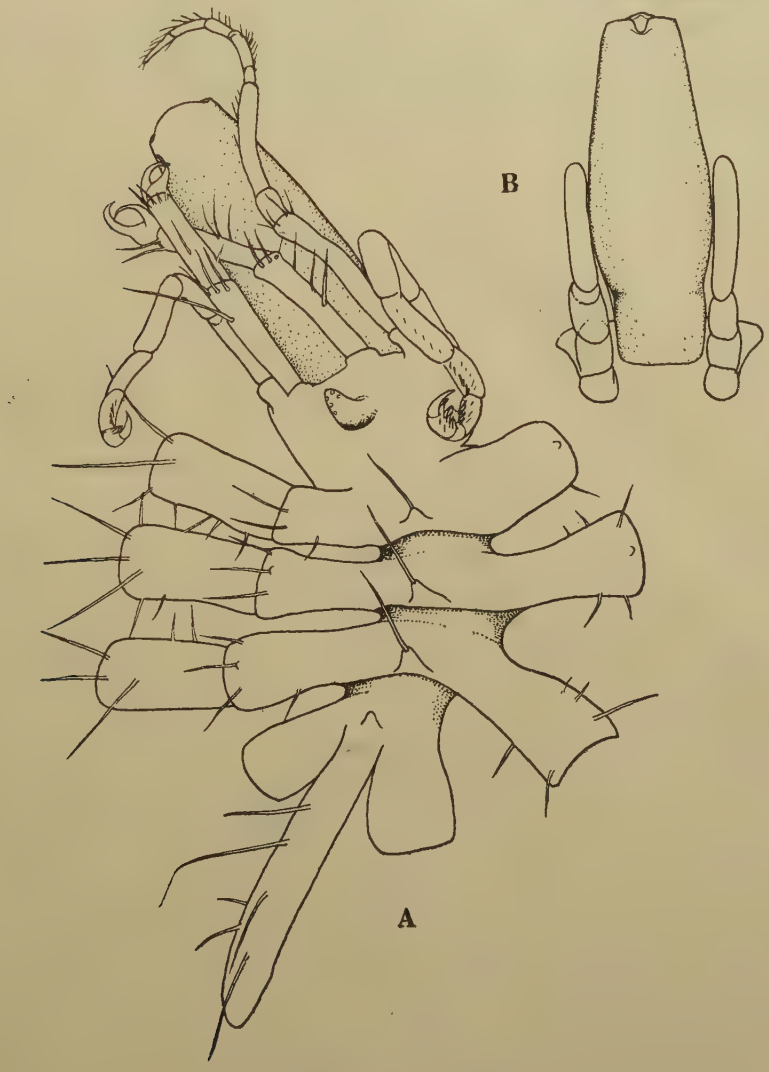

Fig. 17. *Heterofragilia amica* STOCK.
A, dorsal view of trunk, legs omitted; B, ventral view of proboscis.
(All ×11)

Above all, the proboscis is directed forward as in the genotype *H. fimbriata* HEDGPETH (1943, 1948), instead of downward as STOCK indicates. It is not certain whether such posture is due to an artifact by fixative or intrinsic to the species. The

general outline of the proboscis is, however, quite similar; it is nearly cylindrical, with a slight constriction at about the proximal one-fourth of its length. The frontal opening is broad, and distinctly notched on its ventral side as in *H. fimbriata*, recalling somewhat the corresponding portion of the proboscis in the preceding *Cilunculus armatus*; this feature is not clear in STOCK's figure.

Chelifore rather prominent, a little shorter than proboscis. Scape 2-jointed, second joint a trifle shorter than first, each bearing long setae distally and on outer margin. Chela with strongly incurved fingers, gaping when closed.

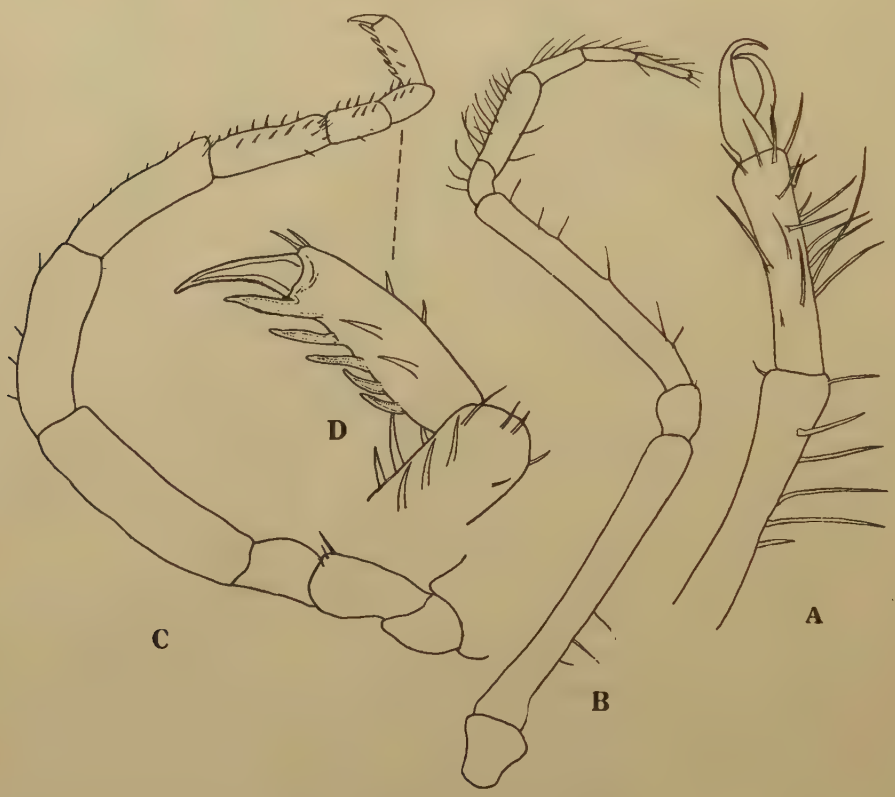

Fig. 18. *Heterofragilia amica* STOCK.
A, chelifore; B, palp; C, oviger; D, distal joints of oviger. (A–C, ×21; D, ×67)

Palp 9-jointed, second joint the longest, distal 5 joints slender, with numerous setae ventrally.

Oviger 10-jointed, with short terminal claw. Seventh to tenth distal joints furnished with 3 rows of small but stiff setae or spines. On the terminal joint there are 5 stronger spines ventrally, the last one of which is the strongest. According to the formula generally adopted, the spines (or setae) are arranged as follows:

Ventral row	7 : 4 : 3 : 5
Lateral row	5 : 3 : 3 : 2

Terminal claw strong, but a trifle longer than half of the adjoining last joint.

Eye tubercle tall (about 1.4 mm long), slender, acute, provided distally with trace of setae; no eyes visible.

Conical tubercles on the dorsum of trunk, from segment 1 to 3, each bearing a seta distally, are about 0.6 mm high, whereas that on segment 4 is low, about 0.3 mm high and naked. Lateral processes and abdomen are furnished with several long setae (up to 2 mm long) on dorsal surface, especially distally in the abdomen. All the legs, except the basal coxal joints which are as long as the lateral processes, are unfortunately missing.

Measurements of a specimen (in mm)

Length of proboscis	4.3	Diameter of proboscis	1.47
Length of trunk	5.0	Length of 2nd lateral process	1.8
Length of abdomen	4.0	Length of chelifore	3.7
Width between 2nd and 3rd lateral processes	1.2		

Genus *Scipiolus* Loman

21. *Scipiolus spinosus* n. sp.

(Fig. 19)

Material: 1 female (Coll. No. 459—S.M.B.L. Type 160), St. 284, Seno-umi, Suruga Bay, 71 m. July 4, 1928.

Description: Body slender, distinctly segmented. Lateral processes widely separated by their own diameter, each armed distally with 2 prominent conical processes. Frontal edge of cephalic segment slightly protruded forward at the base of chelifores. Eye tubercle situated just between the bases of first lateral processes, bluntly pointed, with small eyes near the tip. Abdomen conical, directed upward, shorter than last pair of lateral processes, but longer than eye tubercle. Whole surface of body and appendages closely pitted, but not armed with setae.

Proboscis cylindrical, comparatively small, directed forward; its diameter about half of the own length.

Chelifore very small, naked, 2-jointed; terminal joint achelate, about one-fourth as long as scape.

Palp 9-jointed, slender, with 5 setose distal joints.

Oviger smaller than palp, 9- (or 10-) jointed. Five distal joints curved, the last one of which is armed with 2 denticulate spines, and the penultimate joint with only one.

Legs rather spinose, with prominent rounded tubercles bearing no setae. Coxa 1

armed distally with 2 conical processes like those of lateral processes and in addition one or two smaller tubercles between them. Coxa 2 with 2 tubercles subterminally on dorsal surface and a prominently projecting genital process at ventral distal end where genital pore exists. Coxa 3 shorter than coxa 2, lacking tubercles. Femur and tibia 1 subequal in length, each armed with prominent tubercles, 5 dorsodistally,

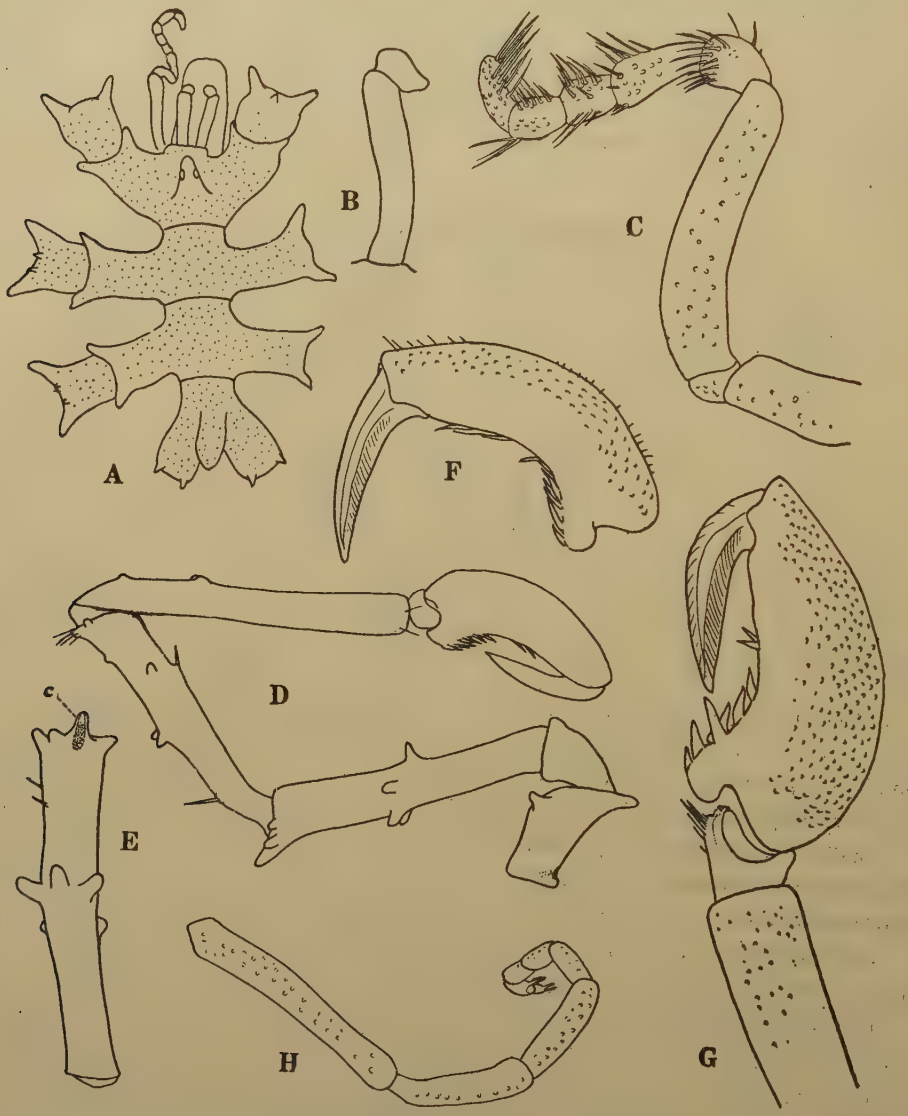

Fig. 19. *Scipiolus spinosus* n. sp.
A, dorsal view of female holotype, legs omitted; B, chelifore; C, palp; D, fourth leg; E, femur in dorsal view, showing the position of cement gland (*c*); F, propodus; G, distal joints of leg; H, female oviger. (A, ×18; D, E, ×21; F, G, ×33; B, C, H, ×53)

2 or 3 about midway on dorsal surface, 1 about midway on each lateral surface and 1 about midway on ventral surface. Tibia 2 the longest of all joints and with 2 smaller tubercles on dorsal surface near the proximal end. Besides, a few simple setae are scattered.

Tarsus the smallest, densely setose ventrally. Propodus curved, stout, with a distinct heel bearing a row of strong spines smaller distally. Terminal claw heavy, about two-thirds as long as propodus; auxiliaries lacking.

Cement gland opens to the central dorso-distal tubercle on femur.

Measurements of the holotype (in mm)

Length of proboscis	0.8	Fourth leg:	
Length of trunk	2.5	coxa 1	0.4
Width between 2nd and 3rd lateral processes	0.47	coxa 2	0.7
Length of abdomen	0.6	coxa 3	0.6
Length of chelifore	0.5	femur	2.0
Length of palp	2.0	tibia 1	2.0
Length of lateral process	0.6	tibia 2	3.0
		tarsus	0.2
		propodus	1.5
		claw	0.65

Remarks: This new species is referable to the unique genus *Scipiolus* which has long been considered as monotypic. The genotype *S. plumosus* LOMAN (1908, p. 58) was only once recorded from Kei Islands in the East Indies based on a single specimen of female. Both are closely related in the general structure, especially in the dwarf proboscis, the achelate small chelifore, the diminutive oviger with a few denticulate spines and the inconspicuous cephalic prolongation. But, the present Japanese form cannot be assigned to *S. plumosus* in the more spinous armature of the lateral processes and legs, in the lack of plumose setae in the legs and in the shape of the propodus.

In several structural details, this genus is close to the genera *Lecythorhynchus* and *Achelia*, so that it should be included in the Ammotheidae.

Family COLOSSENDEIDAE HOEK

Genus *Colossendeis* JARZYNSKY

22. *Colossendeis dofleini* LOMAN

Colossendeis dofleini LOMAN, 1911, pp. 4-5, Pl. I figs. 9-13; OHSHIMA, 1936, p. 867 (listed); HEDGPETH, 1949, p. 300, fig. 47 a-d; UTINOMI, 1951, p. 167.

Material: 5 specimens (Coll. No. 365), St. 293, off Sata-misaki, Kagosima Pref., 203 m. July 10, 1928.

1 specimen (Coll. No. 915), St. 599, N. of Sado Island, 181 m. Aug. 9, 1930.

23. *Colossendeis chitinosa* HILTON

(Fig. 20)

Colossendeis chitinosa HILTON, 1943, p. 4; HEDGPETH, 1949, p. 301, fig. 47e–h; STOCK, 1954, p. 161, fig. 79.

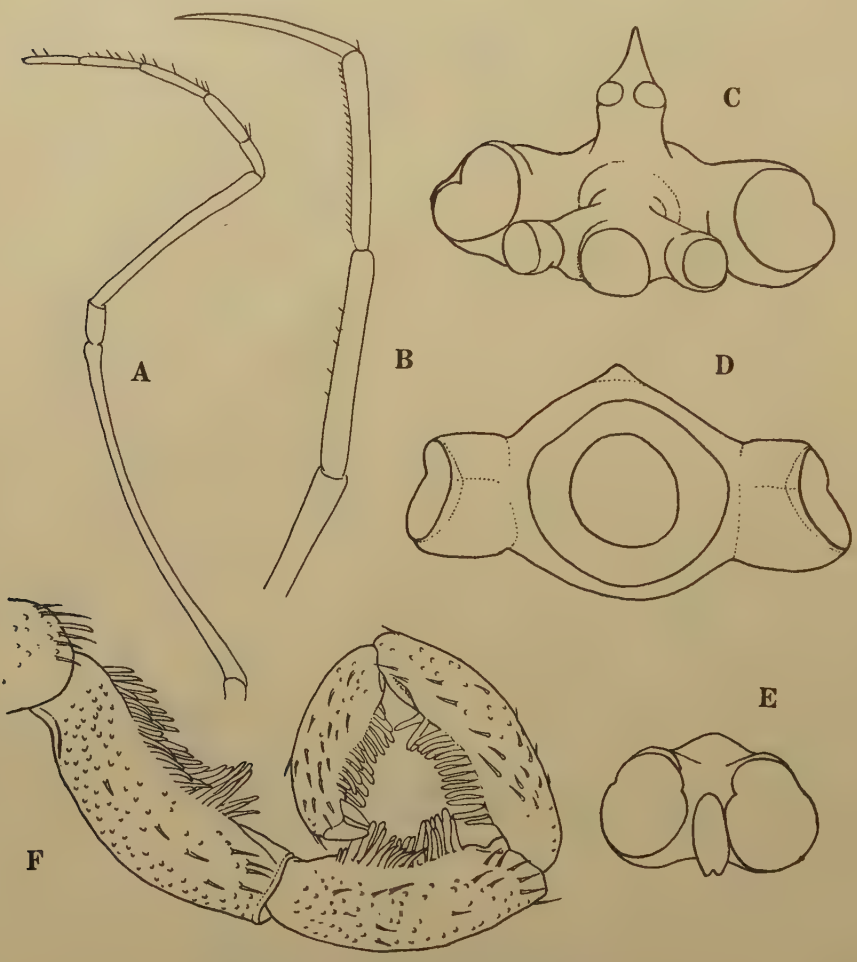

Fig. 20. *Colossendeis chitinosa* HILTON.
A, palp; B, distal joints of leg; C, cephalic segment in front view; D, third segment of trunk in front view; E, fourth segment of trunk with abdomen, viewed from behind; F, distal joints of oviger. (A, B, ×11; C–E, ×21; F, ×67)

Material: 1 damaged specimen (Coll. No. ?), St. 223, Tosa Bay, Kôti Pref., 311 m. July 20, 1927.

1 specimen (Coll. No. 903), St. 469, Okinosima, Tusima Strait, 112 m. July 25, 1929.

1 specimen (Coll. No. 906), St. 549, off Etizen-saki, N. of Wakasa Bay, Hukui Pref., 115 m. July 20, 1930.

1 specimen (Coll. No. 909), St. 568, N. of Noto Peninsula, Isikawa Pref., 90 m. July 27, 1930.

18 specimens (Coll. No. 905), St. 572, N. of Noto Peninsula, Isikawa Pref., 132 m. July 27, 1930.

7 specimens (Coll. No. 924), St. 645, W. of Tugaru Strait, 115 m. Aug. 22, 1930.

Remarks: This species resembles the preceding *C. dofleini* in superficial appearance, but differs from the latter in the very small abdomen directed ventrally, in the more sharply pointed dorsal tubercles and in the subchelate structure of the end of ovigers. The distal joints of ovigers are exceedingly setose; this seems to be one of the characteristics in this species.

Measurements of a male from St. 572 (in mm)

Length of proboscis	6.5	Third leg:	
Length of trunk	4.0	coxa 1-3	2.5
Length of abdomen	0.2	femur	9.0
Length of palp	10.0	tibia 1	10.0
		tibia 2	8.0
		tarsus	2.8
		propodus	2.4
		claw	1.8

24. *Colossendeis nasuta* Hedgpeth

(Fig. 21)

Colossendeis nasuta Hedgpeth, 1949, pp. 302–303, fig. 46e–h.

Material: 1 male (Coll. No. 880), St. 67, off Hatinoe, Aomori Pref., 519 m. July 25, 1926.

Remarks: The material agrees in general with Hedgpeth's description, but differs slightly in minor details.

Trunk elongate, unsegmented, lateral processes separated by their own diameter. Eye tubercle conical, erect, pointed at tip, with 4 indistinct eyes. Abdomen clavate, slender in the middle, longer than last pair of crurigers. All surface of trunk and legs glabrous.

Proboscis cylindrical as in *C. japonica*, but not so tapering distally as in the type. Palp 9-jointed, second joint about twice as long as fourth and fifth joint slightly shorter than sixth.

Terminal joints of oviger strongly curved, bearing 2 (instead of several) rows of rather long, ligulate spines which are usually upturned at tip and very finely serrate marginally. Last joint slender and gradually tapering, with a terminal claw about one-third as long as the joint itself.

Measurements of a male (in mm)

Length of proboscis	7.5	Third leg:	
Length of trunk	6.0	coxa 1–3	3.7
Length of abdomen	1.5	femur	12.0
Length of palp	ca. 11.0	tibia 1	11.0
		tibia 2	7.0
		tarsus	3.0
		propodus	2.8
		claw	3.0

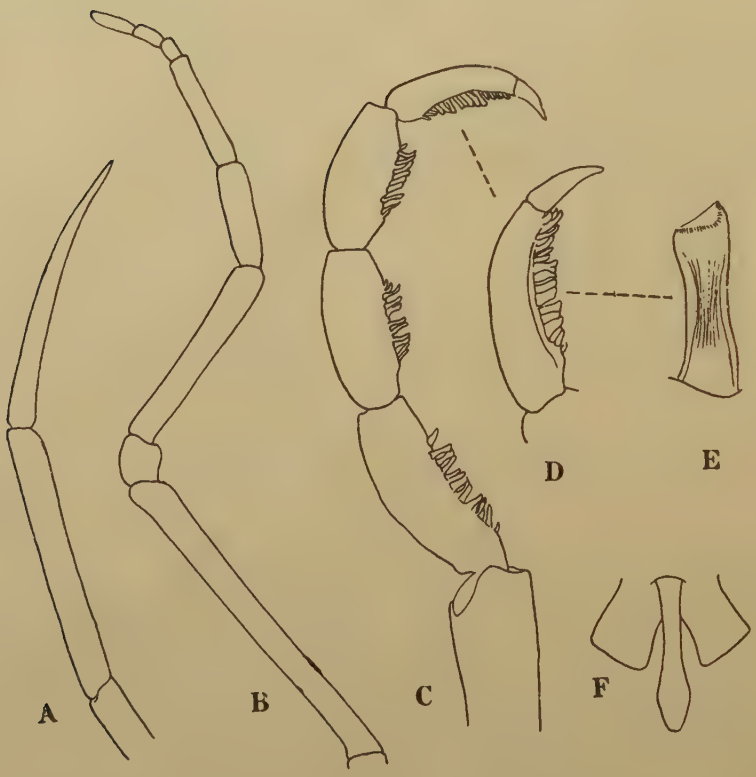

Fig. 21. *Colossendeis nasuta* HEDGPETH.
A, end of leg; B, palp; C, distal joints of male oviger; D, end of oviger; E, ligulate spine of oviger; F, abdomen. (A, B, ×11; F, ×13; C, ×21; D, ×33; E, ×150)

Family PYCNOGONIDAE WILSON

Genus *Pycnogonum* BRÜNNICH

25. *Pycnogonum tenue* (SLATER) KISHIDA

(Figs. 22 and 23)

Pycnogonum littorale var. *tenue* SLATER, 1879, p. 283; ORTMANN, 1891, p. 167; SCHIMKEWITSCH, 1929, pp. 15–18.

P. tenue KISHIDA, 1927, p. 989, fig. 1905; OHSHIMA, 1933, p. 149; OHSHIMA, 1936, p. 867 (listed); OHSHIMA and KISHIDA, 1947, p. 1010, fig. 2865; HEDGPETH, 1949, p. 303, figs. 48 b, 50 c–d; STOCK, 1954, pp. 162–165, fig. 80.

Material: 1 female (Coll. No. 885), St. 215, W. of Kii Channel, 251 m. July 18, 1927.

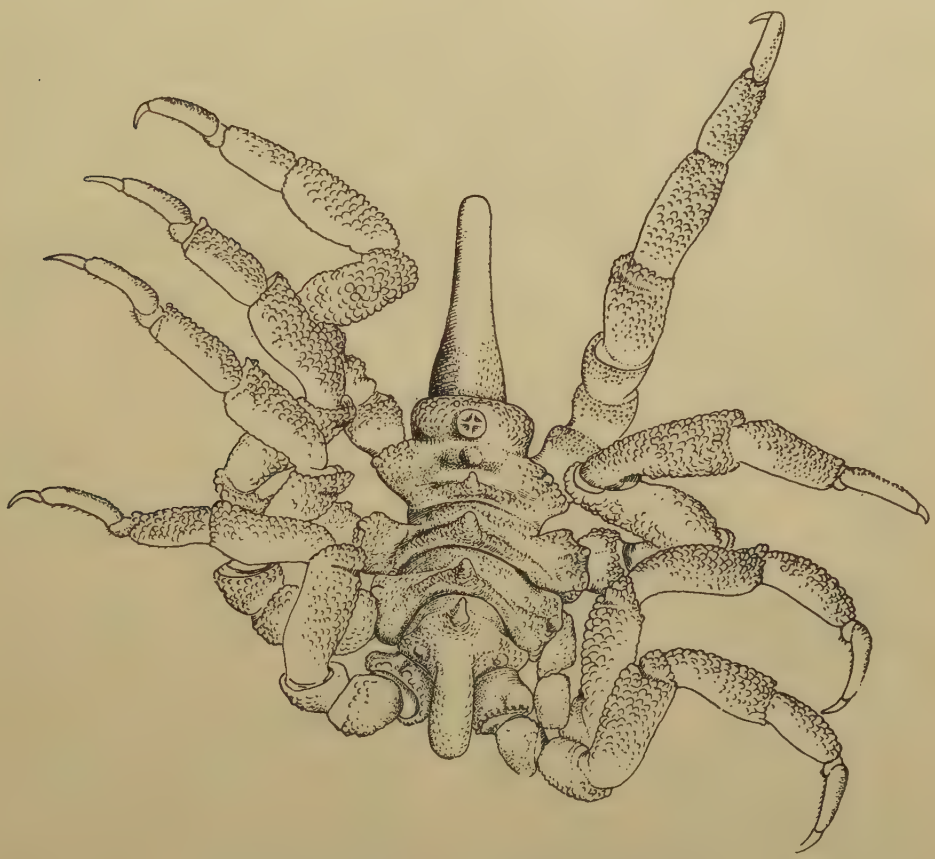

Fig. 22. *Pycnogonum tenue* (SLATER) KISHIDA.
Dorsal view of female. (×11)

Remarks: This little known species, presumably endemic to Japanese deep waters, was first figured by KISHIDA (1927), with an outline of a protonymphon larva and a brief diagnosis of the species, first placing into the specific rank; later the same was reproduced in 1947 as it is, without amendment by Dr. H. OHSHIMA.

In his brief note appended to the figure, however, it is regrettable to find two apparent errors that may mislead one for identification. A note, that is "Eye tubercle

is pretty tall and pointed at tip", is not true; it is nothing but a low cone with 4 distinct eyes. Another note, that is "2 auxiliary claws present", is also incredible.

The most satisfactory description and figures of this species is those of STOCK (1954). Therefore it seems to me to be needless to add much to his excellent work, but it may not be so superfluous to give here some figures and dimensions of the present material.

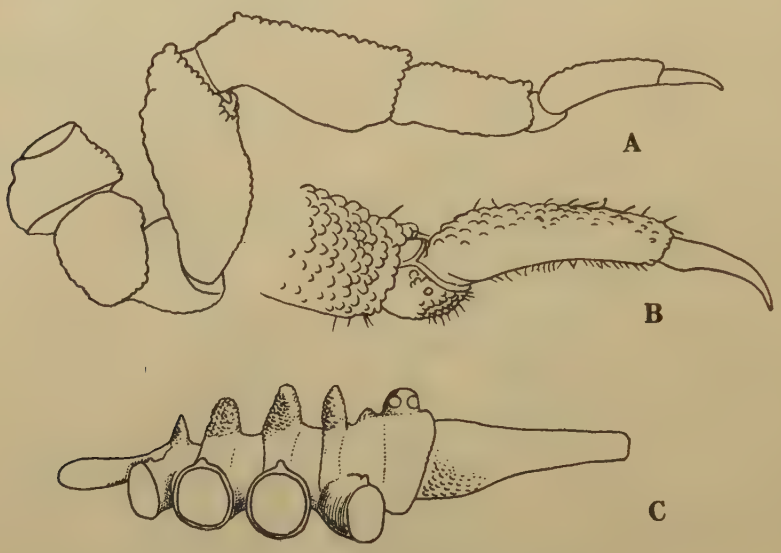

Fig. 23. *Pycnogonum tenue* (SLATER) KISHIDA.
A, third leg, granulated structure omitted; B, end of third leg; C, lateral view of trunk, showing the arrangement of tubercles on dorsum. (C, ×11; A, ×18; B, ×33)

Measurements of a female (in mm)

Length of proboscis	2.0	Third leg:	
Diameter of proboscis at base	0.7	coxa 1	0.5
Length of trunk	3.4	coxa 2	0.7
Width across 2nd crurigers	2.7	coxa 3	0.55
Length of abdomen	1.0	femur	1.7
Height of 3rd dorsal tubercle	0.4	tibia 1	1.4
		tibia 2	0.9
		tarsus	0.3
		propodus	0.9
		claw	0.48

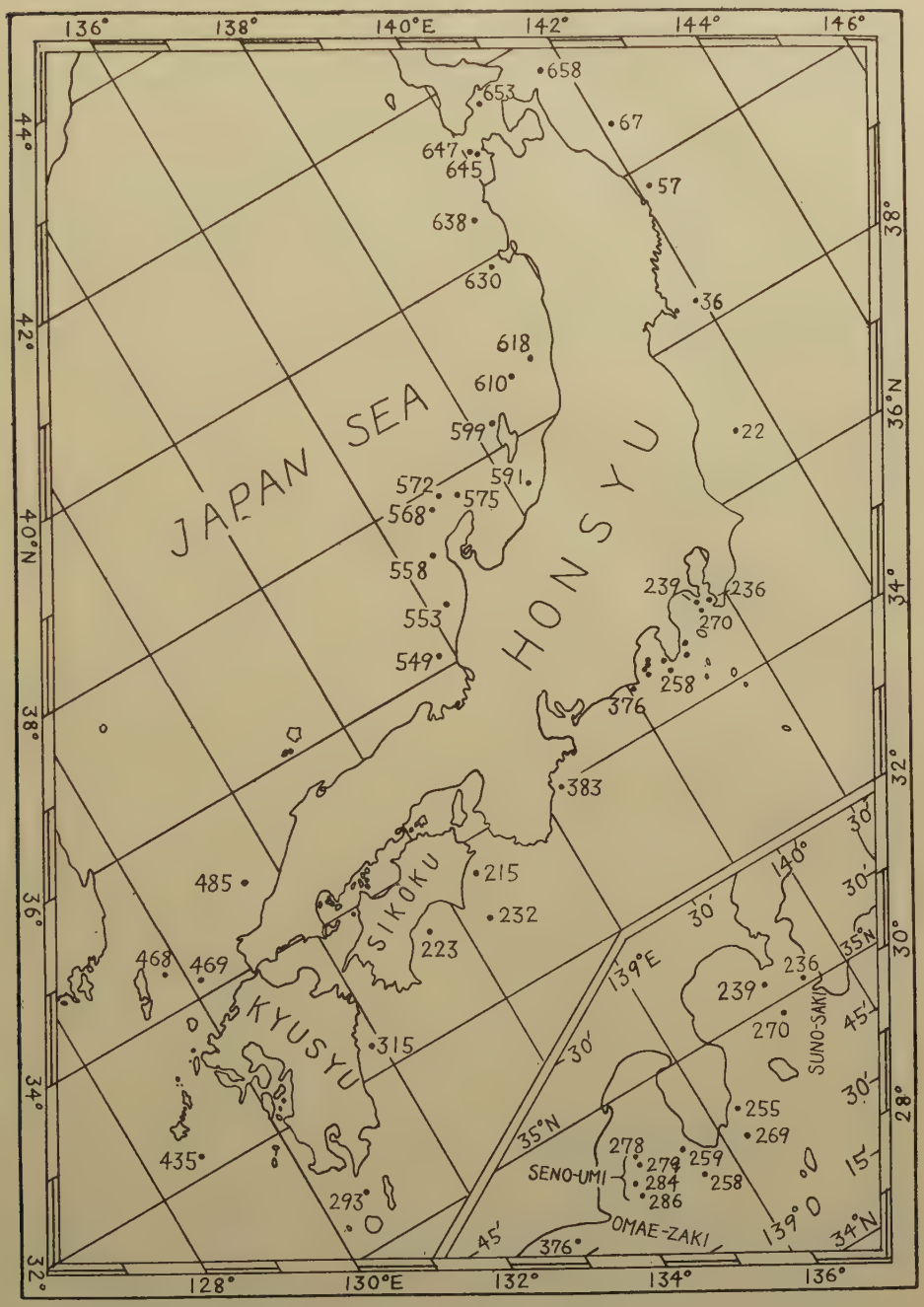

Fig. 24. A chart showing the stations at which pycnogonids were collected by the Sôyô-maru during the years 1926–1930.

Table 2. List of stations at which pycnogonids were collected by the Sôyô-maru, during the years 1926–1930.

Station No.	Date	Locality		Depth (m)	Bottom water temp. (C°)	Bottom character	Pycnogonids collected
		Lat. N.	Long. E.				
	1926						
22	June 29	30°46′40″	141°30′00″	539	4.0	m. S	*Phoxichilidium ungellatum*
36	July 4	38°17′15″	141°56′30″	309	3.4	Cy	*Phoxichilidium ungellatum*
57	July 18	39°44′36″	142°18′10″	494	2.9	m. S	*Nymphon braschnikowi*
67	July 25	40°36′35″	142°10′40″	519	3.6	s. M	*Colossendeis nasuta*
	1927						
215	July 18	33°32′20″	134°32′00″	251	13.6	M	*Pycnogonum tenue*
223	July 20	33°13′50″	133°38′40″	311	9.8	—	*Colossendeis chitinosa*
232	July 30	33°02′00″	134°48′25″	269	16.3	R	*Nymphon japonicum*
236	Nov. 6	35°02′00″	139°46′00″	251	12.9	G	*Ascorhynchus cryptopygium*
							Cilunculus armatus
239	Nov. 6	35°06′00″	139°39′10″	307	12.3	S, St	*Nymphon japonicum*
255	Nov. 10	34°46′15″	139°05′00″	263	13.5	G, m. S, Sh	*Nymphon japonicum*
258	Nov. 15	34°32′50″	138°45′30″	432	6.6	C	*Nymphon japonicum*
259	Nov. 15	34°41′15″	138°43′00″	188	12.0	s. M	*Nymphon japonicum*
269	Nov. 18	34°36′40″	139°00′40″	247	11.2	G	*Nymphon grossipes*
270	Nov. 18	34°59′00″	139°33′40″	91	16.5	C, G	*Nymphon japonicum*
	1928						
278	July 2	34°42′50″	138°30′30″	79	14.8	Cy, G, M	*Pallenopsis sibogae*
279	July 2	34°42′10″	138°30′40″	155	12.3	G, S, Sh	*Nymphon japonicum*
284	July 4	34°38′30″	138°26′30″	71	10.0	G, P	*Scipiolus spinosus*
286	July 4	34°36′10″	138°26′30″	123	14.3	s. M	*Nymphon japonicum*
293	July 10	30°45′00″	130°40′40″	203	14.3	G, P	*Nymphon japonicum*
							Ascorhynchus glabroides
							Heterofragilia amica
							Colossendeis dofleini
315	July 15	32°15′35″	131°50′05″	421	7.2	R	*Achelia superba*
	1927						
383	Dec. 4	33°57′15″	136°22′45″	353	—	—	*Ascorhynchus japonicum*
	1929						
435	July 18	32°10′00″	128°46′45″	324	11.0	S, R	*Nymphon stocki*
468	July 25	34°25′40″	129°47′00″	112	16.1	M, S	*Parapallene nierstraszi*
469	July 25	34°09′10″	130°07′00″	91	18.5	c. S, R	*Colossendeis chitinosa*
485	Aug. 11	34°53′00″	131°18′40″	93	21.1	S	*Ascorhynchus glaberrimum*
	1930						
549	July 20	36°13′00″	135°42′30″	115	15.6	R	*Colossendeis chitinosa*
553	July 21	36°35′15″	136°17′00″	113	18.0	s. M	*Nymphon japonicum*
558	July 22	36°13′00″	136°28′42″	188	11.0	M	*Nymphon soyoi*
568	July 27	37°47′05″	136°50′15″	90	19.3	R	*Nymphon japonicum*
							Colossendeis chitinosa
572	July 27	37°52′55″	137°00′45″	132	16.8	R	*Nymphon stocki*
							Colossendeis chitinosa
575	July 28	37°48′00″	137°18′00″	123	16.8	S	*Nymphon japonicum*
591	Aug. 3	37°27′45″	138°20′50″	311	2.0	R	*Phoxichilidium ungellatum*
599	Aug. 9	38°18′23″	138°21′55″	181	12.1	m. S	*Colossendeis dofleini*
610	Aug. 10	38°52′33″	139°02′50″	145	11.9	R	*Nymphon japonicum*
618	Aug. 14	39°07′30″	139°30′45″	135	3.1	R, Sh	*Nymphon japonicum*
630	Aug. 17	39°52′45″	139°34′00″	150	11.3	R	*Nymphon kodanii*
638	Aug. 18	40°31′15″	139°30′45″	73	16.6	R	*Nymphon japonicum*
645	Aug. 22	41°06′17″	140°09′15″	115	14.4	m. S, Sh	*Nymphon micropedes*
							Colossendeis chitinosa
647	Aug. 23	41°07′30″	140°03′00″	86	18.2	R	*Nymphon micropedes*
653	Aug. 24	41°39′15″	140°39′45″	108	14.7	S	*Nymphon ortmanni*
658	Aug. 30	41°39′00″	141°33′27″	113	16.3	R	*Nymphon micropedes*

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ASCIDIANS FROM THE PALAO ISLANDS. II[1]

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With Plates I–VI and 4 Text-figures

Examining the remaining specimens of the ascidians collected at the Palao Islands, more nine species were discriminated. They are:—

1. *Aplidium lobatum* SAVIGNY
2. *Didemnum moseleyi* (HERDMAN)
3. *Didemnum candidum* (SAVIGNY)
4. *Didemnum ternatanum* (GOTTSCHALDT)
5. *Eudistoma viridis* n. sp.
6. *Eudistoma rigida* n. sp.
7. *Distaplia mikropnoa* (SLUITER)
8. *Polycarpa aurata* (QUOY et GAIMARD)
9. *Pyura* sp.

Among these species, two forms seem to be new to science. In the following, I propose to give descriptions on new species and also on others to certificate my identification.

1. *Aplidium lobatum* SAVIGNY, 1816

(Pl. I, Figs. 1–5)

Aplidium tremulum—SLUITER (1909): Siboga-Exped., LVI b, pp. 99–100.
Aplidium lobatum—VAN NAME (1945): Bull. American Mus. Nat. Hist., Vol. 84, pp. 28–29, Fig. 3.

Many colonies attached to the sea-weeds. Colonies roughly globular in shape, usually ca. 12 mm in diameter and 5–10 mm in height, although larger ones may reach 22 mm in diameter. Colour in life brownish red, but fades to pale sandy in preservation in alcohol. A roundish common cloacal aperture is situated at the apex of the colony and about seven canals are issued radially from the cloacal aperture; about 10 zooids are arranged along each side of the respective canals with their atrial apertures facing towards the canal.

1) Contributions from the Seto Marine Biological Laboratory, No. 268.

Test: The test is covered with muds along the radial canals and the intermediate zones between paired rows of zooids arranged along each side of respective canals. Thus, the test is exposed above zooids; the dorso-anterior part of the thorax of each zooid, just enclosing the area around the dorsal ganglion, shows a silvery glistening when alive. The test is soft gelatinous and contains fine sand grains within it; zooids are easily taken out of the test.

Zooid: Zooids up to 5 mm in length, thorax is slightly longer than abdomen and postabdomen taking both parts together.

Thorax: Branchial aperture distinctly 6-lobed; atrial languet rather short, the tip is simple to trifid. About 13 longitudinal muscles on each side of the thoracic mantle, being converged into a pair of ventral longitudinal muscles along the abdomen; besides large roundish vacuolar cells are scattered on the thoracic mantle. Stigmatal rows 7, stigmata up to ca. 13 in each row. Tentacles 18 including minute ones, dorsal languets short and displaced to the left side from the dorso-median line. Anus is bilobed and opens on the level of the 6th transverse vessel. Incubatory chamber is found near the anus on the right side and contains, for instance, 2 mature eggs in an examined zooid.

Abdomen: Stomach is situated near the middle of the abdomen and provided with 5 stout ridges. A pair of distinct coeca are found at the beginning portion of the rectum. Both hind stomach and mid-intestine are very distinct, the latter occupies the posterior end of the intestinal loop.

Postabdomen: Very short.

Remarks: This species is easily distinguishable from others by its characteristical shape of the colony. Zooids from the colonies in the present material resemble most closely those of the specimens from the West Indies (VAN NAME, 1945).

2. *Didemnum* (*Didemnum*) *moseleyi* (HERDMAN), 1886

(Pl. I, Figs. 6–9)

A small whitish colony, 15 mm×10 mm in extent and 1 mm in thickness, was found on a specimen of *Polycarpa cryptocarpa* collected on the reef of Gadaraku. Calcareous spicules are distributed throughout the test evenly and densely. They are usually about 36 μ in diameter, although larger ones may be up to 53 μ; rays are acutely pointed distally and usually less than 15 in number on the equatorial plane. In some spicules, rays are more numerous, short and bluntly tipped. Zooids are arranged in irregular groups. Thorax ca. 400 μ and abdomen 470 μ in length, the latter is embedded firmly in the test. The outline of circum-intestinal gland is usually indistinct, although it assumes sometimes the appearance as shown in Figs. 8–9. Gonad not found in any examined zooids.

Remarks: Rays of spicules on the equatorial plane are slightly more than in general colonies of *Did. moseleyi*. This feature alludes the possibility of the identity of the present specimen with *Did. candidum*. In general, the circum-intestinal gland is scarcely observable distinctly in *Did. moseleyi*. But it is fairly clear on a few zooids in the present colony. This feature lets me recall the resemblance between the present specimen and species of the subgenus *Polysyncraton*, although no trace of the atrial languet is found on any examined zooids. For these reasons, the present identification is considered rather to be of a provisional nature.

3. *Didemnum* (*Didemnum*) *candidum* (SAVIGNY), 1816

(Pl. II, Figs. 10–17; Text-fig. 1)

Many colonies were found attached to the rock surface near the low water-mark in the canal of Geruherugaeru. They grow to a considerably large size; for instance, larger ones are 40 mm×50 mm to 35 mm×70 mm in extent. Thickness is usually ca. 1 mm, but up to 2 mm at thickened parts or even to 4 mm in exceptional cases. Colour in life varies from pink to crimson, showing many intermediate grades of colouration such as dark pink, scarlet or red; this colouration fades easily to grayish or pale grayish brown in alcohol. Surface of colony nearly even or slightly elevated on respective zooids with each branchial aperture at the apex (Pl. II fig. 12). Common cloacal apertures are scattered here and there and their diameter is as large as that of the zooids. Calcareous spicules are distributed quite evenly and densely throughout the test, or slightly sparse in the middle layer. In many cases, spicules are very sparse in a small area surrounding each branchial aperture which is fringed with dense spicules, and the dark inner side of the colony is seen through this translucent spiculeless area. Thus, in life, a dark brownish ring encircles the white ring in which the branchial aperture is opened. Spicules are small, usually 20 μ or thereabout in diameter and up to 29 μ in maximum in examined colonies. Rays are short and very numerous, usually more than two dozens on the equatorial plane. In some colonies, the tips of rays seem to be pointed more acutely in the superficial layer than in inner or lower layers.

Zooid: Average distance between zooids 490–550 μ. Zooids vary considerably in size; they are usually about 1 mm in length, while they may be nearly 1.7 mm in some colonies. Thorax 450 μ (contracted) to 730 μ (large and expanded), abdomen 550–640 μ; neck region may attain to a considerable length in some zooids. An ear-like thoracic organ at the postero-lateral side of the atrial aperture on each side. Eight to ten stigmata in each of 4 rows. The intestinal loop may be simple in zooids without gonads, but the rectum always curves remarkably in zooids with voluminous gonads. The stomach proper roundish in outline and rather short, while the hind stomach is very large. Anus situated on the level between the 3rd and the 4th stigmatal rows.

Testicular follicle 1 or 2 in some larger zooids. The proximal part of the vas deferens coils 3½ to 7 times.

Larva: Embryos are found in the bottom layer. An examined embryo is 820 μ in length and 680 μ in width. Three cup-shaped attachment processes arranged linearly, four pairs of ectodermal ampullae are found at the base of the attachment processes.

Remarks: A considerable number of small colonies were found attached to the test of specimens of *Polycarpa cryptocarpa* collected on the reef of Gadaraku (Text-fig. 1). They are less than 6 mm×6 mm in extent and the surface of the colony is slightly swollen up. A common cloacal aperture at the centre, the neighbouring areas

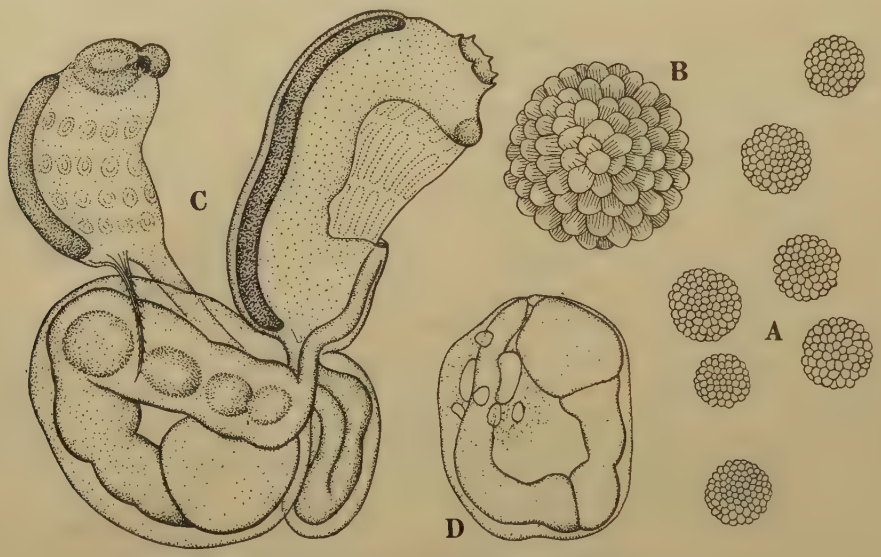


Fig. 1. *Didemnum* (*Didemnum*) *candidum* SAVIGNY.
A—Calcareous spicules, ×440; B—A spicule, ×1200; C—Zooid with a developed bud, ×73; D—Abdomen from right side, ×73.

surrounding the cloacal aperture and some branchial apertures are purplish brown in colour, while the rest is whitish. Spicules ±21 μ in diameter, rays short and numerous; they are found merely in a thin superficial layer. The inner and lower layers of the colony are made with soft translucent tissue and rich in lacunae. Thorax 640 μ in an expanded state and abdomen ca. 470 μ in length. Retractile muscle distinct. Eight stigmata in each of 4 stigmatal rows, tentacles ca. 7. Anus situated on the level of the 3rd transverse vessel. Gonads not yet developed. At the first sight of these specimens, I considered them as being youngs of the following species, because the distribution of spicules and the appearance of budding zooids (Fig. 1 C) are superficially very like *D. ternatanum*. However, the existence of distinct retractile

muscle, quite absence of zoochlorella and fewer tentacles conflict with this identification. Probably these colonies are young ones of *Did. candidum.*

4. *Didemnum* (*Didemnum*) *ternatanum* (GOTTSCHALDT), 1897

(Pl. III, Figs. 18–29)

Didemnoides ternatanum—GOTTSCHALDT, R. (1899) : Synascidien von Ternate. Abh. Senckenberg. naturforsch. Gesell., Bd. XXIV, Hft. 1, pp. 648–649, Taf. XXXV fig. 1.
Didemnum ternatanum—VAN NAME (1918) : U. S. Nat. Mus. Bull. 100, Vol. 1, Pt. 2, pp. 152–155, Figs. 104–106.

Many colonies attached to the leaves of *Enhalus acoroides* (L.f) STEUD near Iwayama Bay and a few ones attached to coral debris. They are roughly dome-shaped, up to 15 mm in diameter at the base and 15–18 mm in height. A roundish common cloacal aperture, about 1.5 mm in diameter, is opened at the apex of the dome and through which the green colouration of the inner-side of the colony can be seen distinctly. The surface of the cone is even and coloured brownish or grayish excepting the margin of the common cloacal aperture and the basal portion of the colony, besides the margin of the branchial aperture of each zooid; all these unpigmented parts are whitish in colour. Zooids are arranged in the surface layer in a single stratum, the voluminous axial part of the colony is occupied by soft gelatinous tissue which is penetrated by complicatedly running lacunae, in which numerous zoochlorellae are kept by mucus. These algal cells are 13–19 μ in diameter and cause the green colouration of the inner-side of the colony. In preserved specimens in alcohol, the surface colouration of the colony fades to pale grayish brown, zoochlorella lose their vivid colour; pale yellowish cells easily flow out through the common cloacal aperture. Calcareous spicules are found merely in the superficial layer, they are small, usually 20 μ or thereabout, although larger ones may be up to 30 μ in diameter. Rays are short and very numerous.

Zooid: Average distance between zooids 680 μ. Zooids are usually less than 2 mm in length, thorax being ca. 1.2 mm and abdomen about 680 μ. In general, a thoracic bud and an abdominal one are found at the neck region. Branchial aperture 6-lobed, atrial aperture a huge opening. About eleven elongate stigmata in each of 4 rows; tentacles 16, consisting of 4 large, 4 small and 8 minute ones; dorsal languets are long and slender. Anus opens at the dorso-posterior corner of the thorax. Circumintestinal gland is represented as a granulate tissue embracing the rectum at its middle part. Testicular follicle 1, proximal portion of vas deferens coils ca. 7 times.

Larva: Trunk of larva is nearly roundish in outline, 700–900 μ in diameter. Three cup-shaped attachment processes are arranged linearly and have each a long peduncle. Three zooids, namely three thoraces and three abdomens, are recognizable in fully developed larvae, of these the dorsal-most zooid is largest and the ventral-most one

is smallest. Thoraces occupies the dorsal-left side of the trunk and abdomens are situated on the right-ventral side. Two pigment flecks of the sensory organ arranged obliquely. The basal plate of the attachment processes is elongate, both dorsal and ventral ends of this plate are bifurcated and each branch grows large with development. Thus, in fully developed larvae 4 distinct ectodermal ampullae are formed (Figs. 28 & 29).

Remarks: If the structure of the vas deferens is placed out of the consideration, the present species resembles closely *Didemnoides patella* GOTTSCHALDT and *Didemnum pulvinum* TOKIOKA (=*D. gottschaldti* TOKIOKA, 1950) in that it has a huge atrial aperture, well-defined thoracic and abdominal buds and a single testicular follicle and contains zoochlorellae in lacunae and calcareous spicules which consist of numerous short rays. *Didemnoides patella* and *Didemnum pulvinum* may be referable to the genus *Lissoclinum*, because the range of this genus was expanded recently to include a species which has merely a single testicular follicle (*Lissoclinum argyllense* MILLAR).[1)]

Furthermore, the boundary between *Lissoclinum* and *Leptoclinum* was removed by CARLISLE's discovery[2)] of delicate spicules in the test of *Leptoclinum* (=*Diplosoma*) *listerianum*. On the other hand, some species of *Didemnum* are known to be entirely devoid of spicules. The abandonment of the genus *Lissoclinum* is considered to be reasonable also from the point of the morphology of the embryo. For instance, the larva of *Lissoclinum cupuliferum* KOTT[3)] resembles essentially those of species belonging to *Leptoclinum*.

Now, the larva of the present species resembles closely those of species of *Leptoclinum*, rather than those of common species of *Didemnum*. This fact, together with the resemblance of the body appearance and the structure of the test between the present species and *Lissoclinum* spp., incite me to treat the present species under the genus *Leptoclinum*. However, the coiling of the proximal portion of the vas deferens in the present species is so distinct that I hesitate to do so. The comprehensive consideration seems to lead me to the idea that *Didemnum* and *Leptoclinum* are completely continuous with each other by the medium of *Lissoclinum* as shown below for instance.

The proximal part of the vas deferens:

(Coils several times)	(Curved like a hook)	(Neither coiled nor curved)
Didemnum spp. ⟵	*Didemnoides patella* ⟵	*Lissoclinum*, *Leptoclinum* spp.

1) MILLAR, R. H. (1950): *Lissoclinum argyllense* n. sp., a new ascidian from Scotland. Jour. Mar. Biol. Ass., Vol. 29, pp. 389–392, 1 Fig.

2) CARLISLE, D. B. (1953): Presenza di spicole in *Diplosoma listerianum* (MILNE EDWARDS). Contributo alla sistematica degli Ascidiacea, Didemnidae. Pubbl. Staz. Zool. Napoli, Vol. XXIV, Fasc. 1, pp. 61–67, 1 Fig.

3) KOTT, P. (1952): Observations on compound ascidians of the Plymouth Area, with descriptions of two new species. Jour. Mar. Biol. Ass., Vol. XXXI, pp. 65–83, 3 Figs.

Structure of larva:

(No budding occurs before the settlement)	(Budding occurs before the settlement)
Didemnum spp. *Lissoclinum argyllense* (See MILLAR 1950)	*Lissoclinum cupuliferum* (See KOTT 1952) *Leptoclinum* spp.

Number of testicular follicles:

(Usually 1 or 2) (Usually 2, 1 or several in some forms) (Usually 2, rarely 1 ?)

Didemnum (*Didemnum*) spp.——*Lissoclinum* spp.————*Leptoclinum* spp.

And the present species can be considered to play also a rôle of an intermediate form between *Didemnum* and *Leptoclinum*, because it has the coiled vas deferens and at the same time it produces larvae in which the budding occurs before the settlement. Thus, *Didemnum*, *Lissoclinum* and *Leptoclinum* are probably united into a single genus, *Didemnum*. But, at present, I wish to restrain a rapid alternation of names and keep the distinction between *Didemnum* and *Leptoclinum* on the basis of the far difference in the coiling degree of vas deferens between the two genera. *Lissoclinum* should be treated as a subgenus of *Leptoclinum* on the basis of the far difference in the degree of the development of calcareous spicules, and to this subgenus belong *Didemnoides patella* and *Didemnum pulvinum*, both treated in my previous papers under *Didemnum* (*Didemnum*). The existence of zoochlorellae in lacunae seems to be insignificant phylogenetically.

5. *Eudistoma viridis* n. sp.

(Pl. IV, Figs. 1–5)

Many colonies attached to the debris of reef corals in the canal of Geruherugaeru. They assume usually small roundish masses, about 10 mm × 10 mm in extent and 7–8 mm in height; although larger ones attain to the size 25 mm × 27 mm or 13 mm × 37 mm and to the height about 13 mm. The basal portion of the colony is generally narrowed considerably. Test soft gelatinous and translucent, the surface is free from any foreign matters. In life, the test is coloured pale greenish and through it the distinct colouration of zooids is seen clearly: (Fig. 2) endostyle, the neighbourhood of dorsal ganglion, peripharyngeal bands, margins of both branchial and atrial apertures are coloured bluish green, besides a fleck of the same colour is found on each side of the atrial aperture; the alimentary organ orange brown. This colouration is changed to greenish gray or to dark greenish black in preservation in alcohol.

Zooid: Up to ca. 5 mm in length, abdomen is longer than thorax in preserved specimens. A vascular prominence is issued from the posterior end of the abdomen and in strongly contracted zooids, it assumes the appearance as if it were the postabdomen. Both apertures 6-lobed. The anterior part of the thorax in front of the peripharyngeal band retains the pigmentation in a preserved state and the abdomen

is also coloured faintly, while the remaining part of the thorax is quite transparent. About 25 elongate stigmata in each of three rows; ca. 15 stout tentacles, comprising large and small ones; dorsal languets are displaced to the left side. Anus is situated on the level of 2nd transverse vessel, two-lobed and smoothly margined. Stomach at nearly the middle of the abdomen, it is roughly globular, smoothly walled and coloured orange. Hind-stomach and mid-intestinal region very distinct. The rectum begins at the posterior end of the intestinal loop, its proximal portion is thickened, but not formed into any coecum. Gonads cover the posterior part of the intestinal loop on the left side, testis consists of numerous botryoid follicles. The incubatory chamber is marked by the pigmentation near the anus on the right side, only an egg is found there in examined zooids (Pl. IV, Fig. 4, inc. ch.). As zooids are somewhat large as compared with the colony, the latter comprises only a small number of zooids situated with their ventral sides towards periphery.

Remarks: The present new species resembles closely *Polycitor glaucus* SLUITER from the Siboga Area, but the latter has much fewer stigmata in each stigmatal row, only 8–10. These numbers are less than a half of that in the present new species.

6. *Eudistoma rigida* n. sp.

(Pl. V, Figs. 6–10)

One encrusting colony from the reef of Gadaraku. It is very hard and 40 mm ×100 mm in extent and ca. 10 mm in thickness, some thickened massive parts being up to 30 mm. The colouration in life is dark greenish with a yellowish green tint at some places of the colony, but this colouration changes uniformly to bluish black in preservation in formalin.

Test: The test is very compact and hard in consistency and carries no foreign matter on the surface or within it, except in the thickened places where some faecal pellets are embedded in the test. The surface is nearly even excepting a few wide but low swellings arranged irregularly, besides a minute promninence above each zooid.

Zooid: Zooids may be up to 6 mm in length and yellowish brown in colour when alive, system quite indistinct. Thorax rather short, about 1/4 of the whole body length in a preserved state. Both apertures 6-lobed, the atrial siphon considerably thick. Probably fourteen to fifteen elongate stigmata in each of three rows: tentacles 10–12, excluding minute ones; ciliated groove is an oval orifice; dorsal languets are slightly displaced to the left side. Anus is situated on the level of the 2nd transverse vessel and bilobed. Stomach is situated on the level of about a third of the length of the abdomen from the posterior end and roughly reniform in profile (Fig. 10) and smoothly walled. Mid-intestinal region distinct and passes to the rectum at the posterior end of the intestinal loop; the proximal part of the rectum is swollen but not forming any coecum. The circum-intestinal gland assumes several tubular tissues

surrounding the rectum on the level of the hind-stomach (fig. 9). Testis consists of many follicles filling up the intestinal loop posterior to the stomach, two ova are found near the centre of the testis in examined zooids. A thin vascular prolongation is issued from the posterior end of the abdomen.

7. *Distaplia mikropnoa* (SLUITER), 1909

(Pl. V, Figs. 11–16; Text-fig. 2)

Ten massive colonies in the material, larger ones are 15 mm × 25 mm, 13 mm × 40 mm or 20 mm × 35 mm in extent and 8–15 mm in height; the basal portion is narrowed in some colonies. The colouration in life is yellowish orange to brownish orange with darker pigmentation at some parts and dotted with whitish pigment spots which are arranged usually as to divide the surface of the colony into several areas. In preservation in alcohol, it is changed to yellowish brown. Test gelatinous and translucent, but very tough in consistency, being strongly adherent to zooids, of which the abdomen and the postabdomen can hardly be taken out of the test without any injury. The surface is free from foreign matters, several round common cloacal apertures are found here and there; system indistinct. The common cloacal aperture is fringed with a number of lobules which are nothing else than distal ends of atrial languets of zooids and marked with white colouration (Fig. 14). The margin of the branchial aperture is sometime provided with a whitish lobe which is probably the prolongation of one of the branchial lobes of respective zooids (Fig. 13).

Zooid: Zooid ca. 4 mm in length, the thorax being about a half of the abdomen in length and the postabdomen is nearly as long as the thorax in a preserved state. The proximal portion of the postabdomen is elongated to a thin peduncle of a considerable length. The mantle coating the whole zooid is richly dotted with corpuscles. Branchial aperture 6-lobed; atrial aperture is a huge opening, situated asymmetrically and with a conspicuous atrial languet ending in a simple tip. About eighteen stigmata in each of 4 rows, *parastigmatic vessels absent. No papilla on the transverse vessels.* Tentacles about a dozen, dorsal languets distinct. Anus bilobed and situated on the level of the 3rd transverse vessel. Stomach is situated near the middle of the abdomen, elliptical in outline and with about 10 fine longitudinal plications on each side; hind-stomach distinct; mid-intestinal region is inconspicuously discernible. Rectum begins slightly in front of the posterior end of the intestinal loop on the first branch. Gonads in the distal swollen part of the postabdomen, one ova situated distally and testicular follicles, for instance 16 in an examined zooid, located proximally.

Larva: Many large embryos are found in the colony, although no incubatory pouch is discriminated distinctly. The trunk of a large larva is 1240 μ in length, width/length being 0.74. Three cup-shaped attachment processes are arranged in a triangle, each with a swollen base. Larval test is conspicuously granulated with

abundant test cells. The body organization of a zooid is nearly completed in well-developed larvae; ca. 7 longitudinal muscles are found on each side of the thorax, ca. 15 stigmata are counted in each stigmatal row and fine longitudinal plications can already be discriminated clearly on the stomach (Text-fig. 2).

Remarks: The present species is one of the most perplexing forms in the material. The appearance of the postabdmen resembles that of *Polyclinum*, but the absence of the papillae on the transverse vessels of the branchial sac, simply stretched intestinal loop and the wide atrial aperture deny the affinity to that genus. Stretched intestinal loop, with considerably well-defined stomach plicated longitudinally, shows some resemblance to *Aplidium*. However, the huge atrial opening and the structure of the larva contradict this consideration. General body appearance, with characteristical arrangement of ovary and testis in the saccular postabdomen, and the organization

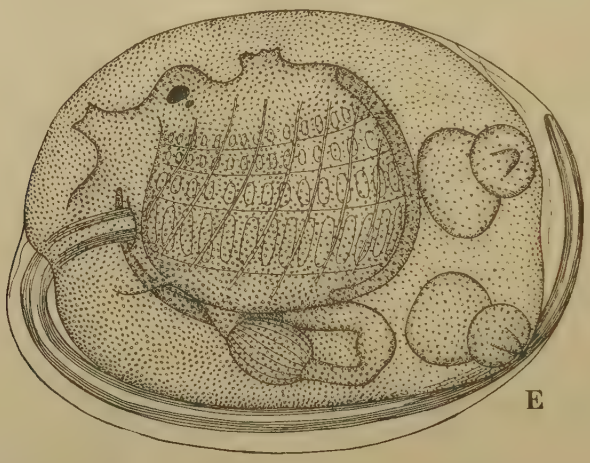


Fig. 2. *Distaplia mikropnoa* (SLUITER).
Embryo from right side, ×57. One of the three attachment processes, situated on the left side, is omitted in the figure.

of the larva are nothing else than good indicators for the genus *Distaplia*, although the relative largeness of the abdomen is too much for this genus and the parastigmatic vessel is quite absent. Especially, the last point is very important; the definition of the genus must be expanded to include forms without parastigmatic vessels in order to embrace the present species in the genus. Superficially the present species resembles closely *Distaplia stylifera* (KOWALEVSKY) in the appearance of the zooid, but the former differs from the latter distinctly in the absence of the parastigmatic vessels and the extraordinary wideness of the atrial aperture. Most probably, the present form may be identical with *Polyclinum mikropnous* SLUITER from the Siboga area. The differences found between these two forms, for instance in the size of the atrial aperture and in the appearance of the genital organs, may be attributable to the differences in the state of contraction or in the degree of maturity.

8. *Polycarpa aurata* (QUOY et GAIMARD), 1834

(Pl. VI, Figs. 17–20; Text-fig. 3)

Polycarpa sulcata—HERDMAN (1882): Challenger Report, Vol. 6, pp. 179–180, Pl. 23 figs. 9–13.
v. DRASCHE (1884): Denkschr. der mathem.-naturw. Gl., Bd. 48, pp. 379–380, Pl. VI fig. 12, Pl. VII figs. 1, 2, 2a.
TRAUSTEDT (1885): Vidensk. Meddel. Nat, For. Kjobenhavn, ann. 1884, p. 48.
Styela psoloessa—SLUITER (1890): Natuurk. Tijdschr. Ned.-Ind., Bd. 50, p. 339.
Styela (*Polycarpa*) *pneumonodes*—SLUITER (1895): Denkschr. med. naturwiss. Gl. Jena, Bd. 2, p. 179, Pl. 10 figs. 1–3.
Polycarpa aurata var. *plana*—HERDMAN (1899): Descriptive Catalogue of the Tunicata in the Australian Museum, pp. 51–53, Pl. Cyn. xx figs. 1–5.
Polycarpa aurata—SLUITER (1904): Siboga-Exped., Monogr. 56 a, pp. 57–58.
HERDMAN (1906): Ceylon Pearl Oyster Fish., Suppl. Rep., No. 39, p. 318, Pl. 5 figs. 1–6.
HARTMEYER (1919): Kungl. Sv. Vet. Akad. Handl., Bd. 60, No. 4, p. 40, Pl. I figs. 17–18.
HASTINGS (1931): Great Barrier Reef Exped., Sci. Rep., Vol. IV, No. 3, p. 74.
Polycarpa pedunculata—PIZON (1908): Rev. Suisse Zool., Vol. 16, p. 216, Pl. 12 figs. 21–24.
Pandocia aurata—VAN NAME (1918): U. S. Nat. Mus. Bull. 100, Vol. I, Pt. 2, pp. 94–96, Figs. 47–48, Pl. 25 figs. 5–6.
Polycarpa aurata f. *clavata*—KOTT (1952): Austral. Jnl. Mar. Fresh. Res., Vol. 3, No. 3, pp. 236–237, Fig. 46.

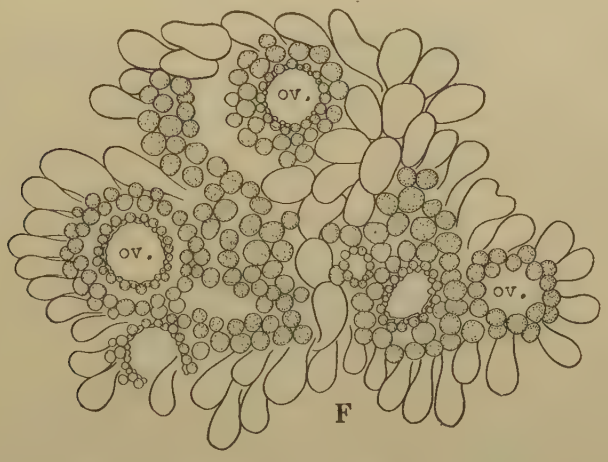


Fig. 3. *Polycarpa aurata* (QUOY et GAIMARD).
A gonad from the side of the attachment, enlarged. ov.—ovary.

A 80 mm long specimen collected at Ponape Island. Width of the body 35 mm at the middle and 40 mm near the posterior end by which the animal attaches to the substratum. The body is considerably compressed laterally, about 10 mm except in the posterior portion where it reaches 17 mm. Branchial aperture terminal, the atrial on the dorsal edge near the middle; both apertures 4-lobed. Test soft leathery, but tough in consistency; yellowish white in preservation in alcohol-formalin. The surface is smooth, free from any foreign matters and marked with a few characteristical

longitudinal grooves. Thickness of test 1 mm, up to 2 mm in the posterior thickened portion; the inner surface is whitish and with pearly glistening. Mantle thin and yellowish brown in colour. Endocarps small, atrial velum is not well-developed.

Branchial sac: Inner longitudinal vessels are arranged as:—

Left	D.	5	(19)	6	(23)	6	(22)	6	(19)	7	V.
Right	D.	6	(23)	5	(23)	5	(22)	5	(17)	6	V.

Three thinner transverse vessels between each pair of thicker ones, parastigmatic vessels are found sparsely in the posterior portion of the sac. Five to nine stigmata in a mesh. Fifteen large tentacles alternate regularly with smaller ones of the same number. Dorsal tubercle large, 3.5 mm in length; ciliated groove divided into 167 short slits (Fig. 20).

Alimentary system: Intestinal loop occupies a small dorso-posterior part of the left side and coloured grayish brown. Oesophagus rather long; stomach narrow and elongate, occupies about 2/3 of the ventral branch of the loop and superficially with smooth surface, through which ca. 8 longitudinal plications of the inner wall are seen faintly. Three minute endocarps in the loop. The axis of the second intestinal loop passes through the cardiac portion of the stomach, anus fringed with ca. 20 lobules.

Gonad: Forty-eight gonads are scattered on the left side and 51 gonads on the right side. They are wholly burried in the mantle. However, the situation of respective gonads is indicated by ducts and irregularly arranged attachment points of endocarps and mesenterial filaments (Text-fig. 3). The gonad itself is very irregular in outline, larger ones may reach 5 mm in diameter and contains several ovaries which are indicated clearly by circular arrangement of minute ova (ov. in Text-fig. 3).

9. *Pyura* sp.

(Pl. VI, Figs. 21–23; Text-fig. 4)

A 18 mm long × 10 mm wide specimen from the reef of Gadaraku. The body is roughly elliptical in outline and erected, being attached by the posterior end. The branchial aperture terminal and the atrial on the level of a third of the body length from the anterior end; both apertures 4-lobed. Test yellowish white in colour and not thick, but very tough in consistency. The surface carries many sand grains and wrinkled considerably. Mantle with well-developed musculature, the anterior half, including both siphons nearly as long as a third of the body length, is coloured red and the posterior half is yellowish white. Atrial velum well developed, no endocarp is detectable.

Branchial sac: As the left half of the mantle body is injured severely, I can give only the following notes about the branchial sac. Probably six branchial folds

and a rudimentary seventh (the ventral-most) one. About 10 inner longitudinal vessels on each fold and ca. 2 on respective intermediate areas in the central part of the sac. Transverse vessels arranged in the order of large-small-medium-small-large. Three to five stigmata in a mesh. Tentacles ca. 20, including large and small ones; branches in 2 orders, those of the 1st order are rather slender. Ciliated groove of the shape of lying S; dorsal lamina represents a series of finger-shaped languets.

Alimentary system: Mutilated so much that I can not offer here any detail, excepting that the liver is dark greenish in colour and consists of many elongate mammilary lobules (fig. 23).

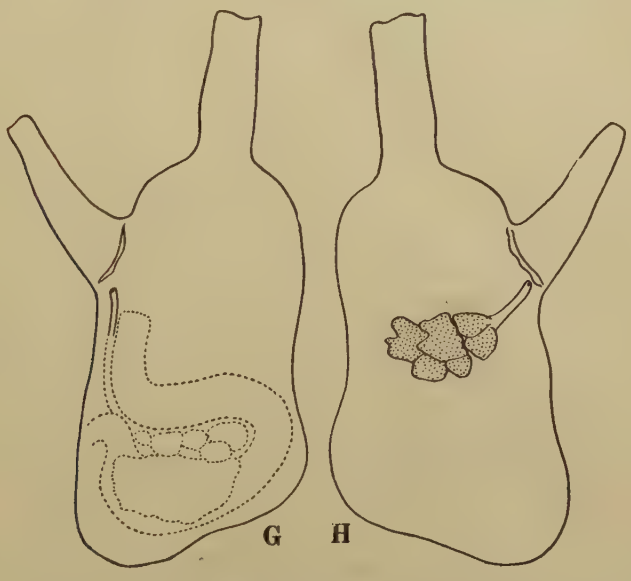


Fig. 4. *Pyura* sp.
G—Right half of mantle body, from inside; H—Left half of mantle body, from inside.

Gonad: Right gonad is very short and consists of 6 genital capsules. The left one is torn out, but it was probably located in the intestinal loop as in other common pyurids, because the distal end of the genital duct of the left gonad is opened near the posterior base of the atrial siphon.

Remarks: It is sure that the present specimen belongs to the genus *Pyura*, and it is very possible that the specimen represents a new form characterized by short gonad. However, I restrain here to give new name to the specimen, because it is injured too much to be used as a type-specimen.

EXPLANATION OF PLATES I–VI

PLATE I

Figs. 1–5. *Aplidium lobatum* SAVIGNY.
1 .....Colonies attached to a piece of sea-weeds, slightly enlarged.
2 .....A colony, enlarged.
3 .....Zooid from left side, magnified.
4, 5 ...Atrial languets of different shapes, magnified.
Figs. 6–9. *Didemnum* (*Didemnum*) *moseleyi* (HERDMAN).
6 .....Calcareous spicules, ×440.
7 .....Zooid from left side, ×110.
8, 9 ...Circum-intestinal glands in different appearances, magnified.

PLATE II

Figs. 10–17. *Didemnum* (*Didemnum*) *candidum* SAVIGNY.
10, 11...Calcareous spicules, ×440.
12 .....A part of the surface of a colony, ×15.
13 .....Smaller zooid from left side, ×73.
14 .....Abdomen of the same zooid from right side, ×73.
15 .....Larger zooid from left side, ×73.
16 .....Abdomen of the same zooid from right side, ×73.
17 .....Embryo from right side, ×73.

PLATE III

Figs. 18–29. *Didemnum* (*Didemnum*) *ternatanum* (GOTTSCHALDT).
18 .....A colony, enlarged.
19 .....Optical section of colony.
20 .....Calcareous spicules, ×1200.
21 .....Zoochlorellae, ×1200.
22 .....Zooid from left side, ×47.
23 .....Abdomen of the same zooid from right side, ×73.
24 .....Tentacles, magnified.
25 .....Young embryo, ×47.
26 .....Well-developed embryo, ×57.
27 .....An attachment process, magnified.
28, 29...Basal plates of attachment processes in different stages of development, magnified.

PLATE IV

Figs. 1–5. *Eudistoma viridis* n. sp.

1 .....A colony, enlarged.
2 .....Apical view of a zooid, magnified.
3 .....Zooid from left side, magnified.
4 .....Abdomen of the same zooid from right side, magnified.
inc. ch....incubatory chamber.
5 .....Contracted zooid, ×23.

PLATE V

Figs. 6–10. *Eudistoma rigida* n. sp.

6 .....Colony, ×0.4.
7, 8.....Zooid, magnified.
9 .....Abdomen, gonads being taken off ; magnified.
10 .....Stomach in profile, magnified.

Figs. 11–16. *Distaplia mikropnoa* (SLUITER).

11 .....Upper side of a colony, slightly enlarged.
12 .....Lateral side of the same colony.
13 .....Branchial aperture with a lobule, magnified.
14 .....A part of the common cloacal aperture, magnified.
15 .....13 mm long small colony.
16 .....Zooid from right side, ×23.

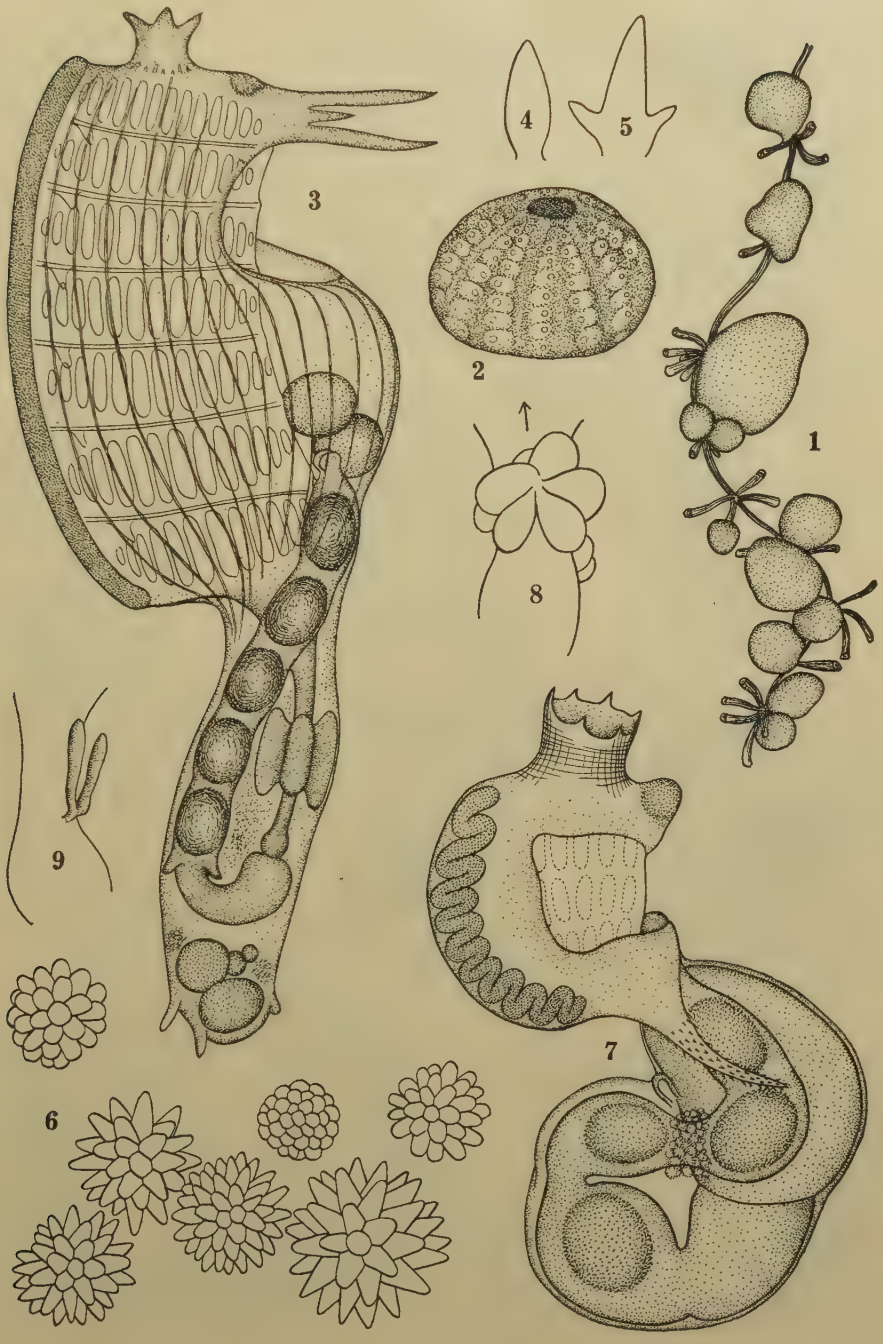
PLATE VI

Figs. 17–20. *Polycarpa aurata* (QUOY et GAIMARD).

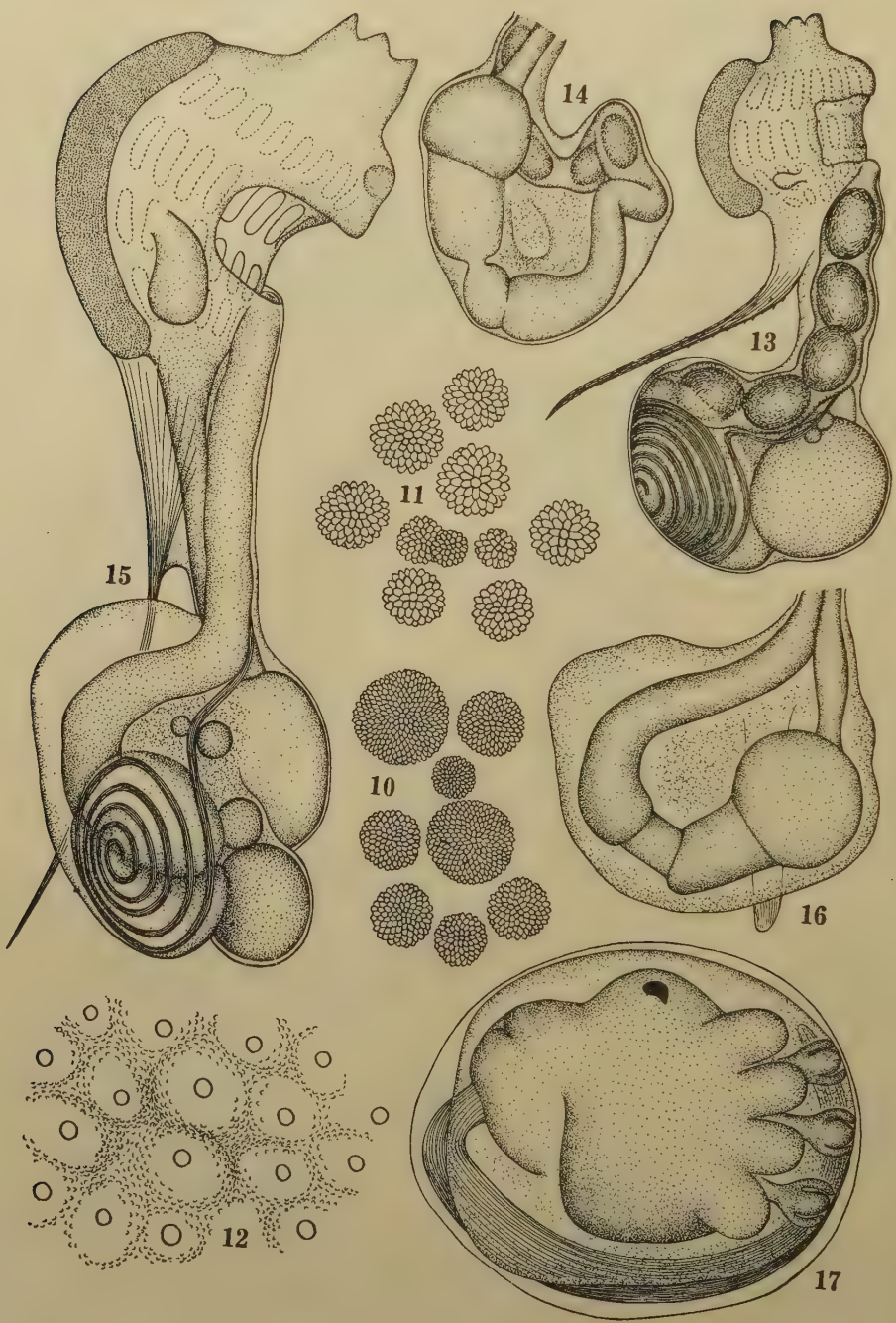
17 .....80 mm long individual from left side.
18 .....Left half of mantle body, from inside.
19 .....Right half of mantle body, from inside.
20 .....Dorsal tubercle, enlarged.

Figs. 21–23. *Pyura* sp.

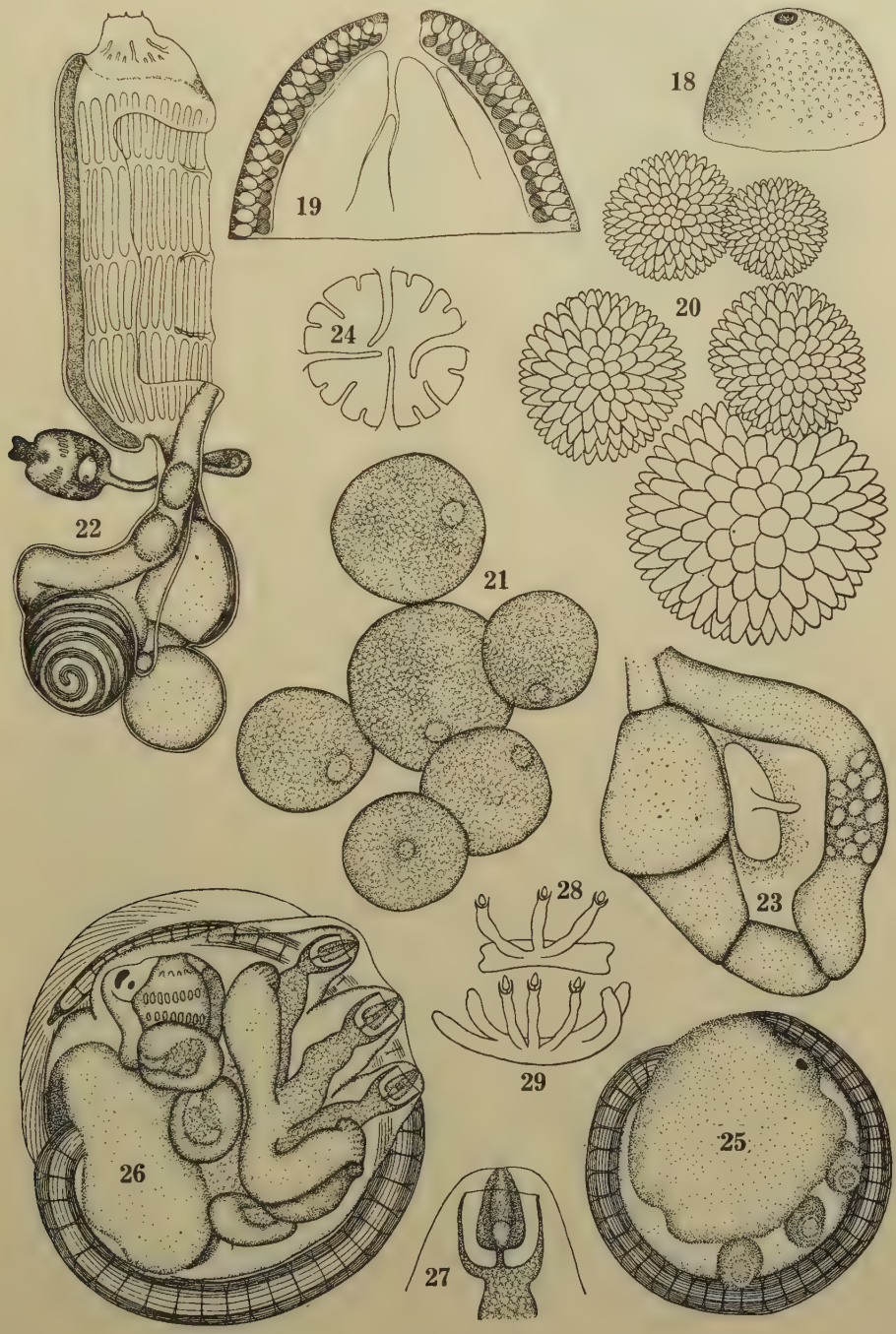
21 .....18 mm long individual from left side.
22 .....Ciliated groove, magnified.
23 .....A part of liver, magnified.



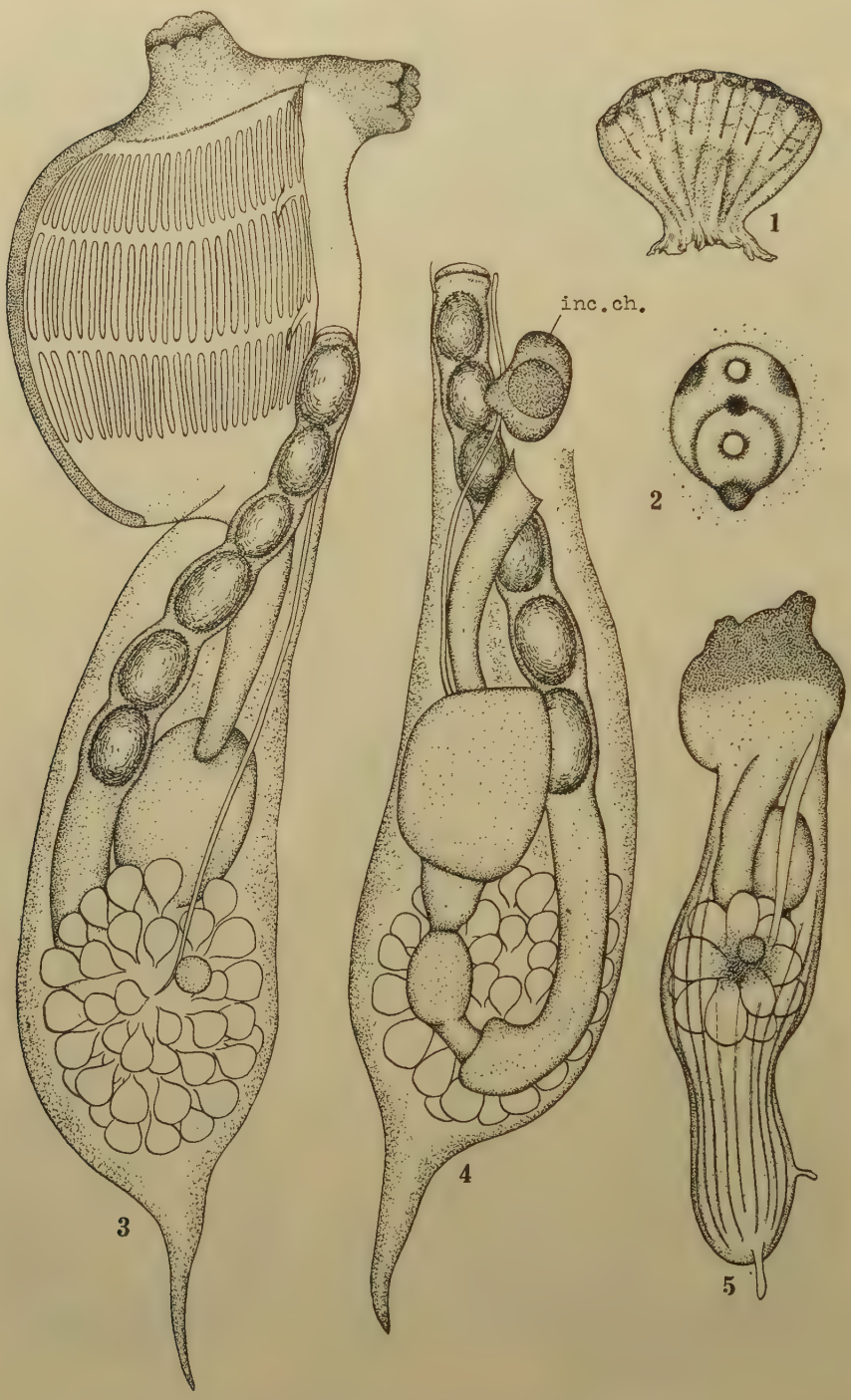
T. Tokioka: Ascidians from the Palao Islands, II.



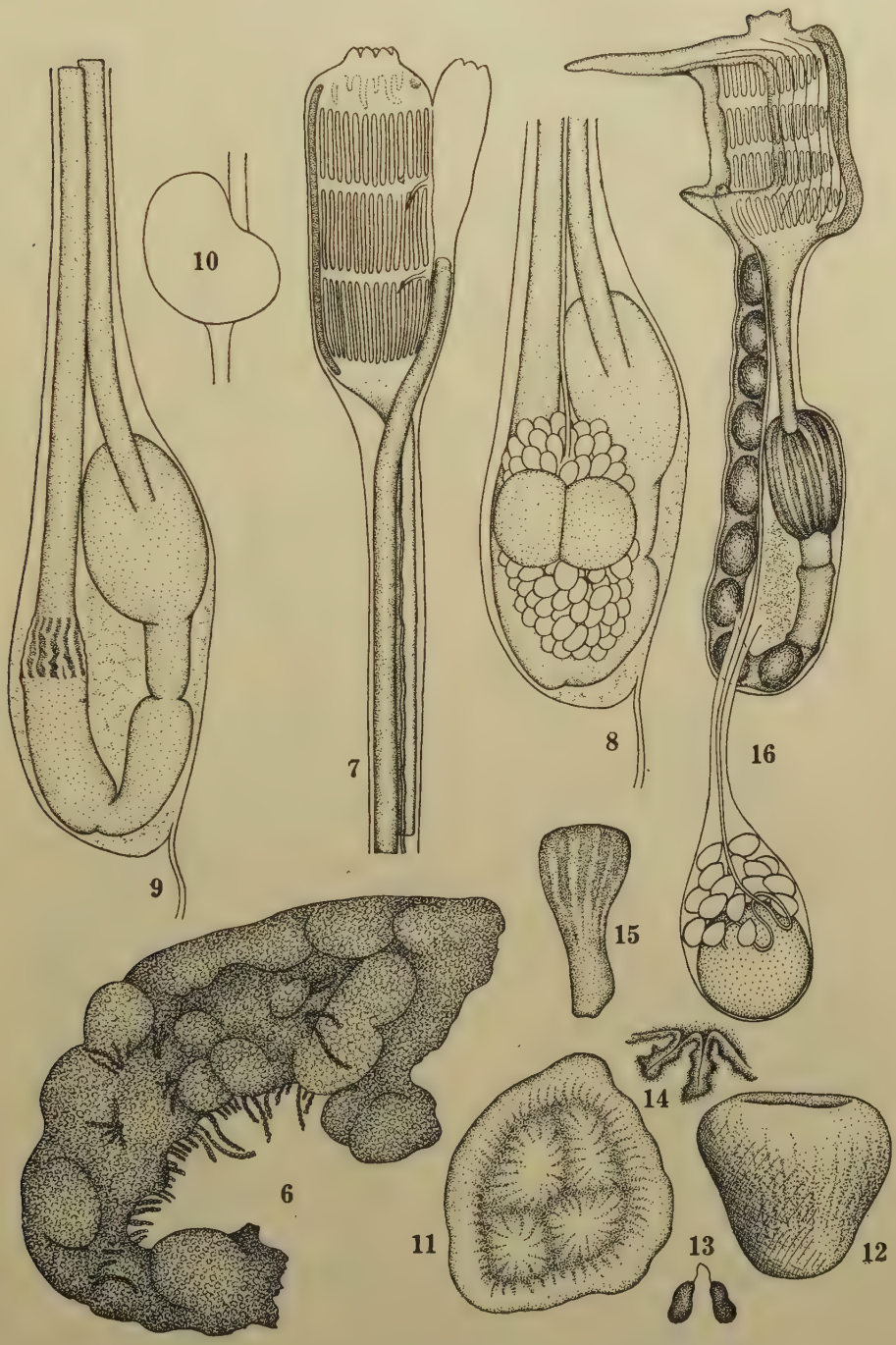
T. Tokioka: Ascidians from the Palao Islands, II.



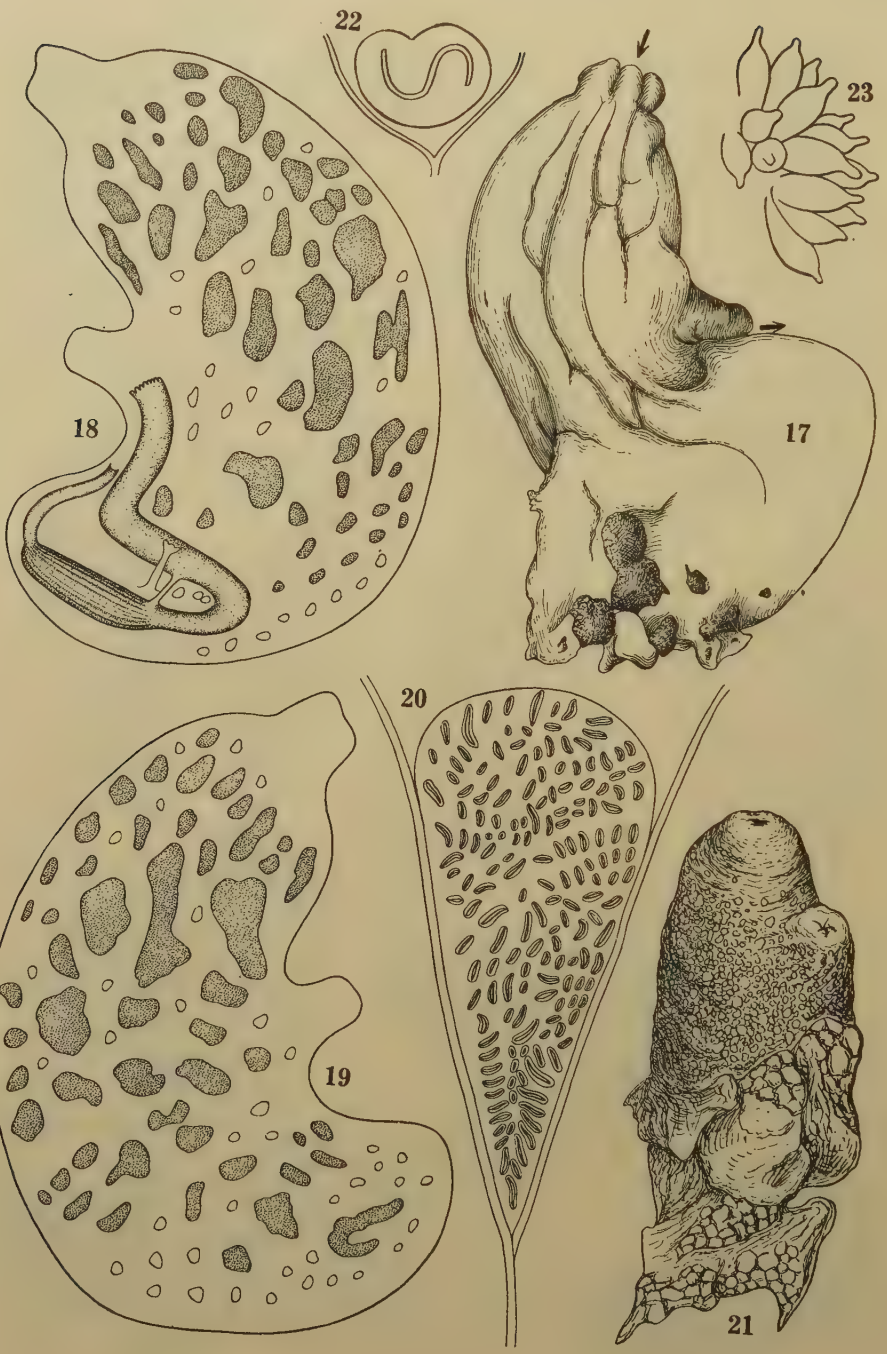
T. Tokioka: Ascidians from the Palao Islands, II.



T. Tokioka: Ascidians from the Palao Islands, II.



T. Tokioka: Ascidians from the Palao Islands, II.



T. Tokioka: Ascidians from the Palao Islands, II.

ON SOME PLANKTON ANIMALS COLLECTED BY THE SYUNKOTU-MARU IN MAY-JUNE 1954

IV. THECOSOMATOUS PTEROPODS[1)]

TAKASI TOKIOKA

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With Plates VII-XIII and 1 Text-figure

The present material comprises the following 23 species and 3 forms:—

EUTHECOSOMATA

Fam. Limacinidae	Individual number	Frequency of occurrence
1. *Limacina trochiformis*	31	10/28
2. *Limacina inflata*	39	5/28
3. *Limacina lesueuri*	2	1/28
4. *Limacina bulimoides*	7	2/28
Fam. Cavoliniidae		
5. *Euclio pyramidata lanceolata*	11	4/28
6. *Creseis virgula virgula*	15	5/28
6a. *Creseis virgula conica*	21	6/28
7. *Creseis acicula acicula*	59	9/28
7a. *Creseis acicula clava*	11	3/28
8. *Styliola subula*	77	4/28
9. *Hyalocylix striata*	8	4/28
10. *Cuvierina columnella*	1	1/28
11. *Diacria trispinosa trispinosa*	9	5/28
12. *Diacria quadridentata quadridentata*	12	5/28
13. *Cavolinia tridentata tridentata*	22	9/28
14. *Cavolinia longirostris longirostris*	5	4/28
14a. *Cavolinia longirostris angulata*	5	3/28
15. *Cavolinia uncinata*	1	1/28
16. *Cavolinia globulosa*	2	2/28
17. *Cavolinia inflexa labiata*	10	6/28

1) Contributions from the Seto Marine Biological Laboratory, No. 269.

PSEUDOTHECOSOMATA

Fam. Peraclididae		
18. *Peraclis reticulata*	1	1/28
19. *Peraclis apicifulva*	1	1/28
Fam. Cymbuliidae		
20. *Cymbulia sibogae*	4	1/28
21. *Corolla ovata*	6	4/28
22. *Corolla intermedia*	1	1/28
23. *Desmopterus papilio*	7	6/28

Most grown shells of the above-listed species can be identified unmistakably, but shells of some small species, young shells of many species and pseudoconchae are liable to be confused. Here, to certificate my identification I wish to give some brief notes, figures and results of measurements in the following ways:

(1) Horn shaped shells.—The ratio of the width to the length measured on the level 1 mm (or various distances) apart from the posterior end of the shell, represented by $\frac{\text{width}}{\text{length}}$ (1 mm) in tables. The angle between the tangents on the level, where the value $\frac{\text{width}}{\text{length}}$ is measured, is shown under the name of "Rear angle".

(2) Spiral shells.—In order to show the size of the spire, body whorl and aperture numerically, area of the frontal projection of respective parts of the shell is represented as a percentage of the frontal projection of the whole shell. For instance, the value of the spire is shown in tables in the column indicated simply as "Frontal projection of spire".

1. *Limacina trochiformis* (D'ORBIGNY), 1836

(Pl. VII, Figs. 1-4)

Limacina trochiformis—PELSENEER 1888, TESCH 1904, 1913, 1946; MEISENHEIMER 1905.

Surface of shell is smooth and devoid of any sculptures. Spire is very small as compared with body whorl, SP (the frontal projection of the spire)/BW (the frontal projection of the body whorl, excluding that of the aperture) is 0.07-0.14 in 4 examined specimens, being 0.11 on an average. Aperture large, AP (the frontal projection of the aperture)/BW being 0.55-0.69, 0.61 on an average. Apical angle 75°-96°, 84° on an average. Colour of shell white to faint purplish, columella and the lower part of outer lip purplish, purplish brown or light brownish and sutures on the spire light brownish in some specimens. Umbilicus small, but distinct and deep.

Height	Long diameter	Apical angle	Number of whorls	Frontal projection of		
				spire	body whorl, excluding aperture	aperture
670μ	570μ	75°		7.7	54.6	37.7
680	650	96	4½	4.2	61.0	34.8
810	750	88		5.0	61.3	33.7
840	730	77		7.9	56.5	35.6

Occurrence: St. 1 (1 shell), 2 (8), 3 (5), 12 (1), 19 (3), 20 (3), 21 (3), 27 (3), 28 (3), 29 (1).

2. *Limacina inflata* (D'ORBIGNY), 1836

(Pl. VII, Figs. 5–6)

Limacina inflata—PELSENEER 1888, TESCH 1904, 1913, 1946; MEISENHEIMER 1905, 1906; VAYSSIÈRE 1915.

Shell depressed, spire extremely low and invisible in the side view. In general, the concavity of the outer lip in the upper half is stretched with translucent lamella. Number of whorls usually 3 in fully grown state. Shell translucent and faintly purplish as a whole or tinted yellow-brownish on spire, or even chalky white in some specimens under a peculiar state of preservation. Umbilicus distinct and sometimes so large that an inner whorl may be observable within it.

Height	Long diameter	Whorl formula*	AP : BW	AP/BW
560μ	1000μ	1 : 0.27 : 0.09	37.9 : 62.1	0.61
	1070	1 : 0.28 : 0.1		

* See the measuring method for shells of Atlantidae, Publ. Seto Mar. Biol. Lab., Vol. IV, Nos. 2-3 (1955), p. 228.

Occurrence: St. 10 (5), 13 (8), 27 (5), 28 (18), 29 (3).

3. *Limacina lesueuri* (D'ORBIGNY), 1836

(Pl. VII, Figs. 7–8)

Limacina lesueuri—TESCH 1904, 1913.
Limacina lesueuri—PELSENEER 1888, MEINSENHEIMER 1905, VAYSSIÈRE 1915, TESCH 1946.

Spire low and aperture rather large, SP/BW is 0.16 and AP/BW is 0.77. Shell whitish, slightly tinted yellowish on the spire. Umbilicus distinct, large and deep.

Height	Long diameter	Apical angle	Number of whorls	Frontal projection of		
				spire	body whorl, excluding aperture	aperture
	790μ		3½			
840μ	1070	133°	4	8.3	51.8	39.9

Occurrence: St. 28 (2).

4. *Limacina bulimoides* (D'ORBIGNY), 1836

(Pl. VIII, Figs. 9–10)

Limacina bulimoides—PELSENEER 1888, TESCH 1904, 1913, 1946; MEISENHEIMER 1905, VAYSSIÈRE 1915, MASSY 1932.

Spire is very large and tall, SP/BW being 0.39–0.46 in two measured specimens. Aperture rather small, AP/BW is 0.54–0.56. Shell translucent and nearly colourless, faintly purplish or whitish in some cases under a peculiar state of preservation. Columella brownish, lower part of outer lip is frequently coloured purplish or brownish. Sutures, most frequently the lowest one, may be also brownish. Umbilicus very small or closed entirely in some fully grown specimens.

Height	Long diameter	Apical angle	Number of whorls	Frontal projection of		
				spire	body whorl, excluding aperture	aperture
1030μ	600μ	55°	5			
1140	660	65	5	20.0	51.3	28.7
1410	740	56	6	23.0	50.0	27.0

Occurrence: St. 2 (5), 29 (2).

5. *Euclio pyramidata lanceolata* (LESUEUR), 1813

(Pl. VIII, Figs. 11–13)

Clio pyramidata—PELSENEER 1888, TESCH 1904, MEISENHEIMER 1905.
Clio pyramidata lanceolata—TESCH 1913.
Cleodora pyramidata—VAYSSIÈRE 1915, MASSY 1932.
Euclio pyramidata—TESCH 1946, 1948.

Embryonal shell is elongate and slightly constricted at the base. Tip is pointed very sharply and the curvature of the shell surface is rather inconspicuous. Larval shell slender and shows a section roughly triangular in outline, each angle being rounded. On a 6.7 mm long shell, there are 17 distinct growth lines and a median crest is discriminated in the distal half of the dorsal shell.

Length	$\frac{\text{Width}}{\text{Length}}$ (1 mm)	Rear angle
1.1 mm	0.53	31°
1.6	0.39	21
6.7	0.39	19

Occurrence: St. 2 (4), 13 (1), 28 (2), 29 (4).

6. *Creseis virgula virgula* Rang, 1828

(Pl. IX, Fig. 14)

Clio (*Creseis*) *virgula*—Pelseneer 1888, Tesch 1904.
Creseis virgula—Meisenheimer 1905, Tesch 1946, 1948.
Creseis virgula virgula—Tesch 1913.
Cleodora (*Creseis*) *virgula*—Vayssière 1915.

Embryonal shell is elongate and scarcely swollen. The tip is rounded. The constriction at the base is so faint that practically the embryonal shell is hardly discriminated.

Length	$\frac{\text{Width}}{\text{Length}}$ (1 mm)	Rear angle
1.5 mm	0.5	40°

Occurrence: St. 1 (1), 12 (1), 14 (3), 28 (6), 29 (4).

6a. *Creseis virgula conica* (Eschscholtz), 1829

(Pl. IX, Figs. 15–17)

Clio (*Creseis*) *conica*—Pelseneer 1888.
Creseis conica—Meisenheimer 1905.
Creseis virgula conica—Tesch 1913.
Creseis virgula f. *conica*—Tesch 1948.

Length	$\frac{\text{Width}}{\text{Length}}$ (1 mm)	Rear angle
1.1 mm	0.37	30°
1.4	0.28	14
1.5	0.31	16

Occurrence: St. 1 (1), 2 (13), 10 (1), 16 (1), 28 (1), 29 (4).

7. *Creseis acicula acicula* RANG, 1828

Clio (*Creseis*) *acicula*—PELSENEER 1888, TESCH 1904.
Creseis acicula—MEISENHEIMER 1905, TESCH 1946, 1948.
Creseis acicula acicula—TESCH 1913.
Cleodora (*Creseis*) *acicula*—VAYSSIÈRE 1915.

Embryonal shell is elongate, with rounded tip and shows a slight swelling. The constriction at the base is very slight, but distinct; the shell is slightly thickened at this constricted part.

Occurrence: St. 1 (3), 2 (25), 3 (1), 6 (1), 19 (8), 20 (8), 27 (8), 28 (4), 29 (1).

7a. *Creseis acicula clava* RANG, 1828

(Pl. IX, Figs. 18–19)

Creseis acicula clava—TESCH 1913.
Creseis virgula var. or f. *clava*—TESCH 1946, 1948.

The specimens treated here resemble superficially *Cr. virgula conica*, especially closely in younger shells, although they have embryonal shells of the "*acicula*-type" differing distinctly from those of *Cr. virgula* and its varieties or forms.

Length	$\frac{\text{Width}}{\text{Length}}$ (1 mm)	Rear angle
1.5 mm	0.3	13.5°
1.9	0.3	14

Occurrence: St. 27 (2), 28 (7), 29 (2).

8. *Styliola subula* (QUOY et GAIMARD), 1827

(Pl. IX, Fig. 20)

Clio (*Styliola*) *subula*—PELSENEER 1888, TESCH 1904.
Styliola subula—MEISENHEIMER 1905, 1906; TESCH 1913, 1946, 1948.
Cleodora (*Styliola*) *subula*—VAYSSIÈRE 1915, MASSY 1932.

The embryonal shell is elongate and hardly swollen. The tip is pointed acutely and the base is constricted very slightly. As a whole it resembles very closely the embryonal shell of *Euclio pyramidata*, although the former is much less distinguishable than the latter. The characteristic longitudinal crest is observable already on a 1.9 mm long shell near the distal end. Such young shells resemble superficially young *Creseis* spp., but the appearance of the embryonal shell differs distinctly between these forms.

Length	$\frac{\text{Width}}{\text{Length}}$ (1 mm)	Rear angle
1.9 mm	0.26	11°

Occurrence: St. 2 (42), 3 (4), 28 (16), 29 (15).

9. *Hyalocylix striata* (Rang), 1828

(Pl. IX, Fig. 21)

Clio (*Hyalocylix*) *striata*—Pelseneer 1888, Tesch 1904.
Hyalocylix striata—Meisenheimer 1905, Tesch 1946, 1948.
Hyalocylis striata—Tesch 1913.
Cleodora (*Hyalocylix*) *striata*—Vayssière 1915, Massy 1932.

A 1 mm long young shell is already devoid of the embryonal shell.

Length	$\frac{\text{Width}}{\text{Length}}$ (1 mm)	Rear angle
1 mm	0.54	24°

Occurrence: St. 2 (1), 12 (3), 14 (1), 28 (3).

10. *Cuvierina columnella* (Rang), 1827

Cuvierina columnella—Pelseneer 1888, Tesch 1904, 1913, 1946, 1948; Meisenheimer 1905, Massy 1932.
Cuvieria columnella—Vayssière 1915.

Occurrence: St. 28 (1).

11. *Diacria trispinosa trispinosa* (Lesueur), 1821

(Pl. X, Figs. 23–25)

Cavolinia trispinosa—Pelseneer 1888.
Cavolinia (*Diacria*) *trispinosa*—Tesch 1904.
Diacria trispinosa—Meisenheimer 1905, Vayssière 1915, Massy 1932, Tesch 1946, 1948.
Diacris trispinosa trispinosa—Tesch 1913.
Cleodora compressa—Pelseneer 1888, Tesch 1904, Vayssière 1915.

I refer here only to young shells known to us under the name of "*Cleodora compressa* Souleyet." Shell is compressed very much; the lateral edges are thickened to ribs excepting in the distal portion rapidly growing. In general, many fine growth lines are observable on the surface excepting in the posterior part. Embryonal shell nearly spherical, frequently coloured brownish as well as in the adjacent portion.

Length	Width / Length	Rear angle
1.5 mm	0.24 (8/7 mm)	8°
1.7	0.21 (8/7 mm)	8
2.4	0.21 (8/7 mm)	7
3.4	0.24 (10/7 mm)	9
3.5	0.21 (2 mm)	9
4.2	0.29 (1 mm)	

Occurrence: Grown shells St. 11 (2); Young shells St. 12 (3), 14 (1), 28 (1), 29 (2).

12. *Diacria quadridentata quadridentata* (LESUEUR), 1821

(Pl. X, Figs. 27–28; Pl. XI, Fig. 26)

Cavolinia quadridentata—PELSENEER 1888, VAYSSIÈRE 1915.
Cavolinia (Diacria) quadridentata—TESCH 1904.
Diacria quadridentata—MEISENHEIMER 1905, TESCH 1946, 1948.
Diacria quadridentata quadridentata—TESCH 1913.
Cleodora pygmaea—PELSENEER 1888, TESCH 1904.

Young shells, "*Cleodora pygmaea* BOAS", are usually coloured yellowish brown. They may be whitish sometimes, even in such cases the lateral ribs are coloured yellowish brown. The growing distal margins, especially of the dorsal shell are generally fringed with transparent lamella. A median and two lateral longitudinal depressions, and many fine growth lines are observable on the dorsal shell. The distal margin of the ventral shell is nearly always broken off, this part is considered to be extremely fragile. The embryonal shell nearly spherical.

Length	Width / Length	Rear angle
1.2 mm	0.39 (8/7 mm)	25°
1.3	0.43 (8/7 mm)	25
1.8	0.29 (1 mm)	14
2.7	0.32 (2 mm)	17
2.9		27

Occurrence: Grown shells St. 17 (1), 20 (2), 28 (4); young shells St. 12 (3), 19 (1), 28 (1).

13. *Cavolinia tridentata tridentata* (FORSKÅL), 1775

(Pl. XII)

Cavolinia tridentata—PELSENEER 1888, TESCH 1904, 1946, 1948; MEISENHEIMER 1905, VAYSSIÈRE 1915, MASSY 1932.
Cavolinia tridentata tridentata—TESCH 1913.
Pleuropus longifilis— PELSENEER 1888, TESCH 1904.

A considerable number of young shells referable to "*Pleuropus longifilis* TROSCHEL" or "*Hyalaea complanata* GEGENBAUR" were found in the material. These shells are evidently not belonging to *Cav. inflexa*, because distinct lateral longitudinal depressions are clearly shown on the dorsal shell of a large one of the specimens of this series. However, it can not be warranted that all the specimens of this series belong to the single species "*Cavolinia tridentata*"; contrarily it is very possible that they comprise some young shells of one or two other cavolinians, namely *Cav. gibbosa* and *Cav. uncinata*, which I could not distinguish from those of *Cav. tridentata*. In future, statistical analyses on a large data obtained by measuring abundant specimens in various ways will probably be able to separate young shells of these species from one another.

Length	$\frac{\text{Width}}{\text{Length}}$ (1 mm)	Rear angle
1.2 mm	0.69	40°
1.3	0.74	46
1.3	0.63	41
1.3		35
1.4	0.59	31
1.4	0.56	39
1.7	0.8	49
1.7	0.54	30
1.8	0.59	29
2.2	0.83	36
2.4		42
2.6	0.57	32

Occurrence: Grown shells St. 12 (1); young shells St. 1 (1), 2 (2), 3 (1), 10 (1), 12 (9), 13 (4), 19 (1), 27 (1), 29 (1).

14. *Cavolinia longirostris longirostris* (LESUEUR), 1821

(Pl. IX, Figs. 22–22′)

Cavolinia longirostris—PELSENEER 1888, TESCH 1904, 1946, 1948; MEISENHEIMER 1905, VAYSSIÈRE 1915, MASSY 1932.
Cavolinia longirostris longirostris—TESCH 1913.
Hyalaea laevigata—PELSENEER 1888, TESCH 1904.
Cavolinia laevigata—VAYSSIÈRE 1915.

Two young shells referable to "*Hyalaea laevigata* D'ORBIGNY" were found in the

material. As they are rather in a poor state of preservation, I can only give here a result of the measurement on the single specimen.

Length	$\frac{\text{Width}}{\text{Length}}$ (1 mm)	Rear angle
1.2 mm	0.91	54°
1.7		

Progenitors are most frequently coloured faint purplish.

Occurrence: St. 9 (1), 11 (2 young shells), 19 (1), 21 (1).

14a. *Cavolinia longirostris angulata* (SOULEYET), 1852

Hyalaea angulata—TESCH 1904.
Cavolinia longirostris angulata—TESCH 1913, 1948.

Shells are most frequently coloured brownish.

Occurrence: St. 1 (1), 28 (2), 29 (2).

15. *Cavolinia uncinata* (RANG), 1836

Cavolinia uncinata—PELSENEER 1888, TESCH 1904, 1913, 1946, 1948; MEISENHEIMER 1905, MASSY 1932.

Occurrence: St. 13 (1).

16. *Cavolinia globulosa* (RANG), 1850

Cavolinia globulosa—PELSENEER 1888, TESCH 1904, 1913, 1946, 1948; MEISENHEIMER 1905.

Occurrence: St. 12 (1), 28 (1).

17. *Cavolinia inflexa labiata* (D'ORBIGNY), 1836

(Pl. XI, Figs. 29–33)

Cavolinia inflexa—PELSENEER 1888, TESCH 1904, MEISENHEIMER 1905, VAYSSIÈRE 1915, MASSY 1932.
Cavolinia inflexa labiata—TESCH 1913.
Cavolinia inflexa lata—TESCH 1946, 1948.
Hyalaea depressa—PELSENEER 1888, TESCH 1904.

Young shells, "*Hyalaea depressa*", are markedly compressed dorso-ventrally. Narrow posterior part is clearly discriminated, curved dorsads and ending in a rounded tip. Growth lines may be read on the dorsal shell.

Length	Width / Length	Rear angle
0.71 mm	1.0 (5/7 mm)	65°
0.76	1.0 (5/7 mm)	58
0.76	1.08 (5/8 mm)	87
0.96	1.0 (5/7 mm)	72
1.0	1.0 (5/7 mm)	73
1.2	1.0 (0.7 mm)	
	1.14 (1 mm)	68
1.2	1.2 (5/7 mm)	73
1.8	1.0 (0.65 mm)	
	1.14 (1 mm)	73
2.3	0.9 (1 mm)	65

Occurrence: Grown shells St. 2 (1); young shells St. 2 (3), 12 (1), 13 (1), 14 (1), 27 (1), 28 (2).

18. *Peraclis reticulata* (D'ORBIGNY), 1836

(Pl. XIII, Figs. 6–6′)

Peraclis reticulata—PELSENEER 1888, MEISENHEIMER 1905, 1906; VAYSSIÈRE 1915, TESCH 1946, 1948.
Peraclis reticulata var. *minor*—TESCH 1904.
Peracle reticulata—TESCH 1913.

A single specimen from St. 29. Surface of the shell reticulated and yellowish brown in colour. Umbilicus closed.

Height	Long diameter	Apical angle	Number of whorls	Frontal projection of		
				spire	body whorl, excluding aperture	aperture
1.09 mm	0.93 mm	102°	3	2.5	46.2	51.3

19. *Peraclis apicifulva* MEISENHEIMER, 1906

(Pl. XIII, Figs. 7–7′)

Peraclis apicifulva—MEISENHEIMER 1906, VAYSSIÈRE 1915, TESCH 1946, 1948.
Peracle apicifulva+*P. brevispira*—TESCH 1913.

A single shell from St. 20. It is rather in a poor state of preservation, being softened considerably in the preservative. Shell is very thin, its surface is quite devoid of any sculptures and light yellowish brown in colour. Umbilicus closed. The lower protuberance of the outer lip is very delicate.

Height	Long diameter	Apical angle	Number of whorls	Frontal projection of		
				spire	body whorl, excluding aperture	aperture
1.19 mm	0.9 mm	115°	3	2.2	42.9	54.9

20. *Cymbulia sibogae* TESCH, 1904

(Fig. 1, A)

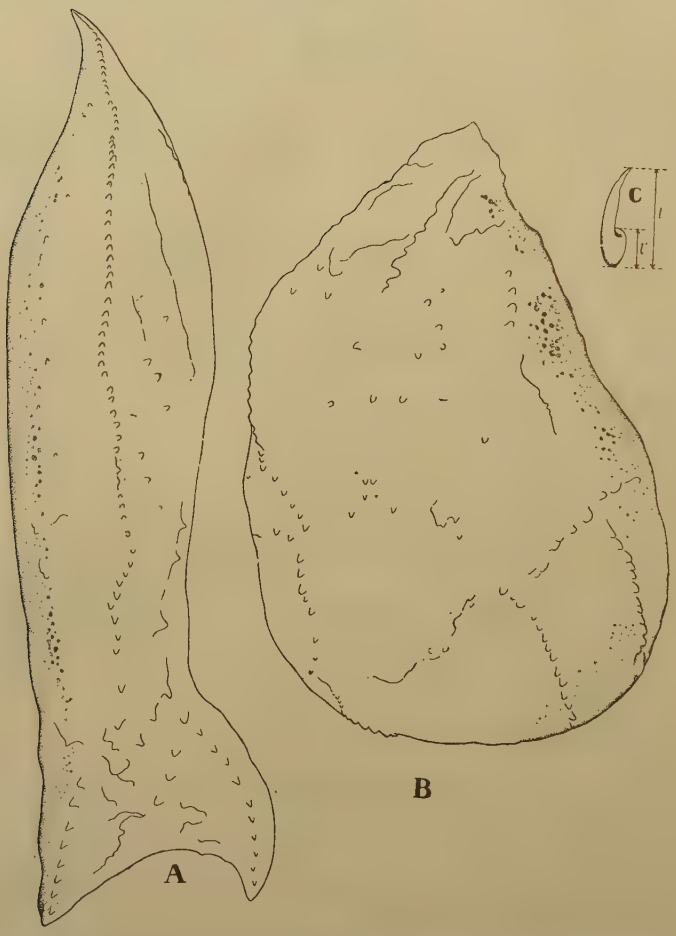

Fig. 1, A—*Cymbulia sibogae* TESCH, 22 mm long pseudoconcha, posterior side. × 7
B —*Corolla ovata* (QUOY et GAIMARD), posterior side of the pseudoconcha. × 7
C—The same pseudoconcha, profile. 1′<½1

Cymbulia Sibogae—Tesch 1904, Meisenheimer 1905.
Cymbulia sibogae—Tesch 1913.

Four pseudoconchae from St. 28, ranging from 8 mm to 22 mm in length. Pseudoconchae very slender, the dorsal part is tapering for a considerable length and ends acutely. A long median spiniferous ridge and two short ventro-lateral ones are observable clearly, although they are all rather low; besides a considerable number of spinules scattered irregularly.

21. *Corolla ovata* (Quoy et Gaimard), 1832

(Fig. 1, B)

Cymbuliopsis ovata—Pelseneer 1888, Tesch 1904.
Corolla ovata—Tesch 1913.

Aperture of pseudoconcha is much longer than a half of the length of the pseudoconcha. The distribution of spinules irregular, although some ones may be arranged in short rows.

Occurrence: St. 3 (1), 16 (1), 20 (1), 28 (3).

22. *Corolla intermedia* (Tesch), 1903

(Pl. XIII, Figs. 8-8′)

Cymbuliopsis intermedia—Tesch 1904.
Corolla intermedia—Tesch 1913.

A single young pseudoconcha referable to this species from St. 19. Pseudoconcha narrower than in the preceding species, 14.5 mm long × 4.5 mm wide; the aperture slightly longer than a half of the length of the pseudoconcha. The distribution of spinules quite irregular.

23. *Desmopterus papilio* Chun, 1889

Desmopterus papilio—Meisenheimer 1905, Tesch 1913.
Desmopterus—Tesch 1946.

Occurrence: St. 1 (1), 11 (1), 17 (1), 20 (1), 28 (2), 29 (1).

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EXPLANATION OF PLATES VII–XIII

Plate VII

Figs. 1–4. *Limacina trochiformis* (d'Orbigny)
1 ···680μ high shell. ×73
1′···The same, apical view. ×73
2 ···670μ high shell. ×47
3 ···840μ high shell. ×47
4 ···810μ high shell. ×47

Figs. 5–6. *Limacina inflata* (d'Orbigny) ×47
5 ···Shell with 1 mm long diameter, apical view.
5′···The same, front view.
6 ···Shell with 1.07 mm long diameter, apical view.
6′···The same, under side.

Figs. 7–8. *Limacina lesueuri* (d'Orbigny) ×47
7 ···840μ high shell.
7′···The same, apical view.
8 ···Shell with 790μ long diameter, apical view.

Plate VIII

Figs. 9–10. *Limacina bulimoides* (d'Orbigny) ×47
9 ···1.14 mm high shell.
9′···The same, right side.
10 ···1.41 mm high shell.
10′···The same, right side.

Figs. 11–13. *Euclio pyramidata lanceolata* (Lesueur)
11 ···6.7 mm long shell, dorsal. ×15
11′···Posterior part of the same shell. ×47
12 ···1.6 mm long shell, ventral. ×47
12′···Section of the same shell. ×47
13 ···1.1 mm long shell. ×47

Plate IX

Fig. 14. *Creseis virgula virgula* Rang, 1.5 mm long shell. ×47

Figs. 15–17. *Creseis virgula conica* Eschscholtz
15 ···1.4 mm long shell. ×73
16 ···1.1 mm long shell. ×47
17 ···1.5 mm long shell. ×23

Figs. 18–19. *Creseis acicula clava* Rang ×47
18 ···1.9 mm long shell.
19 ···1.5 mm long shell.

Fig. 20. *Styliola subula* (Quoy et Gaimard), 1.9 mm long shell. ×47

Fig. 21. *Hyalocylix striata* (Rang), 1 mm long shell. ×47

Figs. 22–22′ *Cavolinia longirostris longirostris* (Lesueur), young shell "*Hyalaea laevigata* d'Orbigny". ×23

22 ···1.2 mm long shell, ventral.
22′···1.7 mm long shell, left side.

PLATE X

Figs. 23–25. *Diacria trispinosa trispinosa* (LESUEUR), young shell "*Cleodora compressa* SOULEYET". ×47
23 ···4.2 mm long shell.
24 ···3.4 mm long shell.
25 ···1.5 mm long shell.

Figs. 27–28. *Diacria quadridentata quadridentata* (LESUEUR), young shell "*Cleodora pygmaea* BOAS".
27 ···2.7 mm long shell. ×33
28 ···1.3 mm long shell. ×47

PLATE XI

Fig. 26. *Diacria quadridentata quadridentata* (LESUEUR), 2.9 mm long young shell "*Cleodora pygmaea* BOAS". ×47

Figs. 29–33. *Cavolinia inflexa labiata* (D'ORBIGNY), young shell "*Hyalaea depressa* TESCH".
29 ···1.8 mm long shell, dorsal side. ×33
29′···The same shell, left side. ×33
30 ···1.2 mm long shell, dorsal side. ×33
31 ···960μ long shell. ×47
32 ···760μ long shell. ×47
33 ···710μ long shell. ×47

PLATE XII

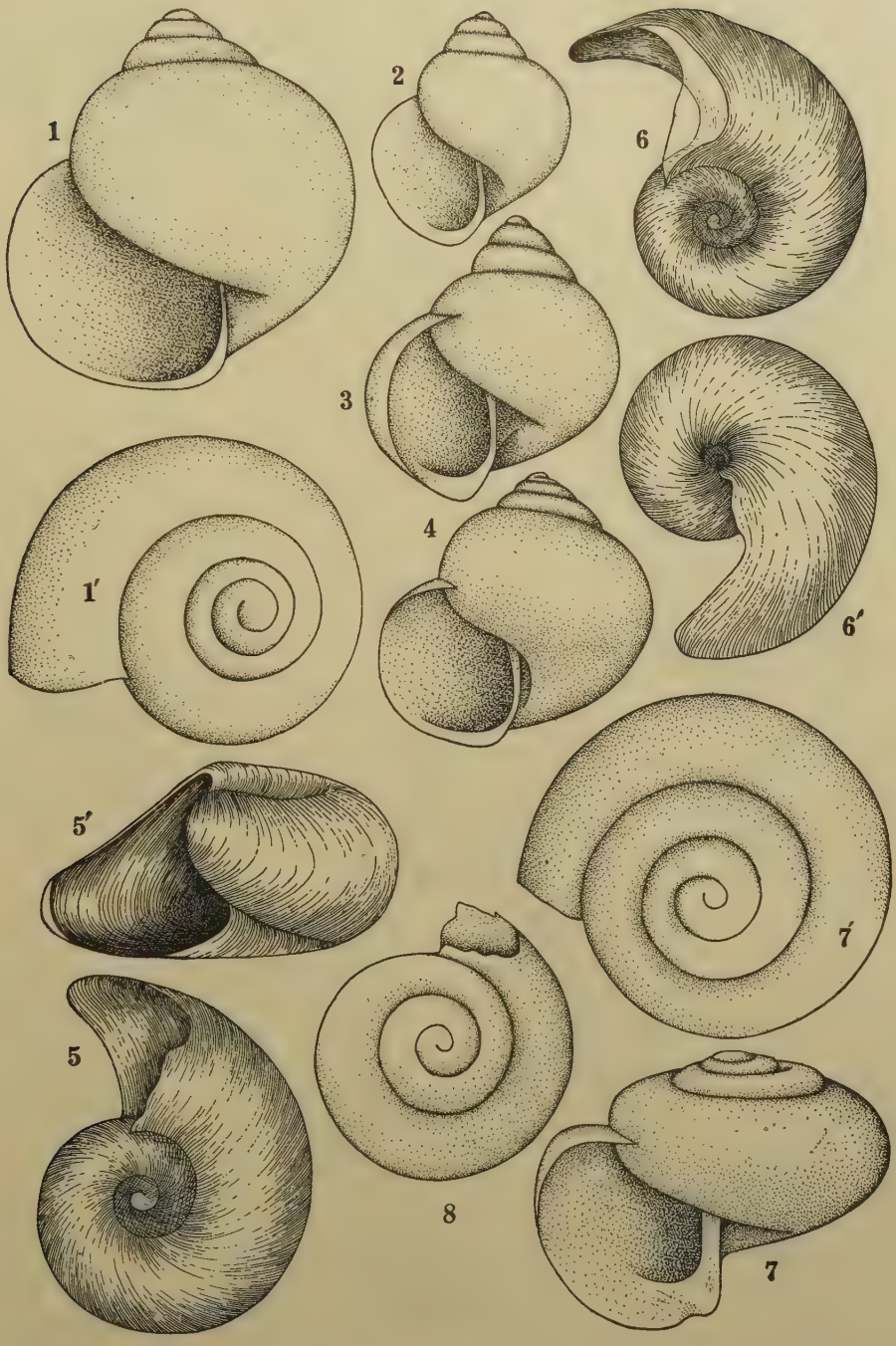
Figs. 1–5. *Cavolinia tridentata tridentata* (FORSKÅL), young shell "*Pleuropus longifilis* TROSCHEL or *Hyalaea complanata* GEGENBAUR".
1 ···2.6 mm long shell, dorsal side. ×47
2 ···1.8 mm long shell, dorsal side. ×47
3 ···1.3 mm long shell, dorsal side. ×47
4 ···1.4 mm long shell, dorsal side. ×47
5 ···1.7 mm long shell. ×23

PLATE XIII

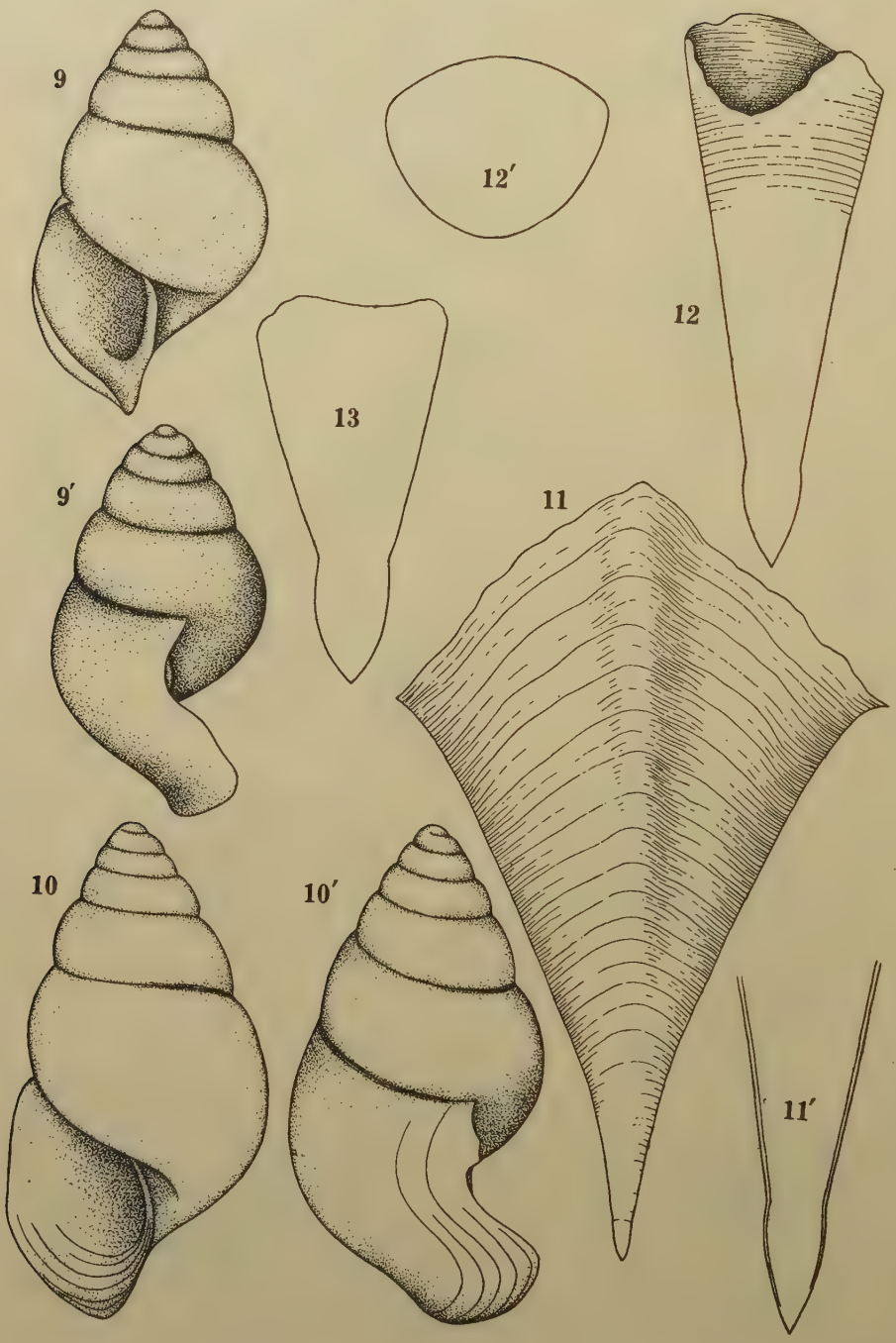
Figs. 6–6′. *Peraclis reticulata* (D'ORBIGNY) ×47
6 ···1.09 mm high shell.
6′···The same, apical view.

Figs. 7–7′. *Peraclis apicifulva* MEISENHEIMER ×47
7 ···1.19 mm high shell.
7′···The same shell, apical view.

Figs. 8–8′. *Corolla intermedia* (TESCH) ×7
8 ···14.5 mm long pseudoconcha, posterior side.
8′···The same pseudoconcha, front view.



T. TOKIOKA: PLANKTON ANIMALS COLLECTED BY THE SYUNKOTU-MARU, IV.



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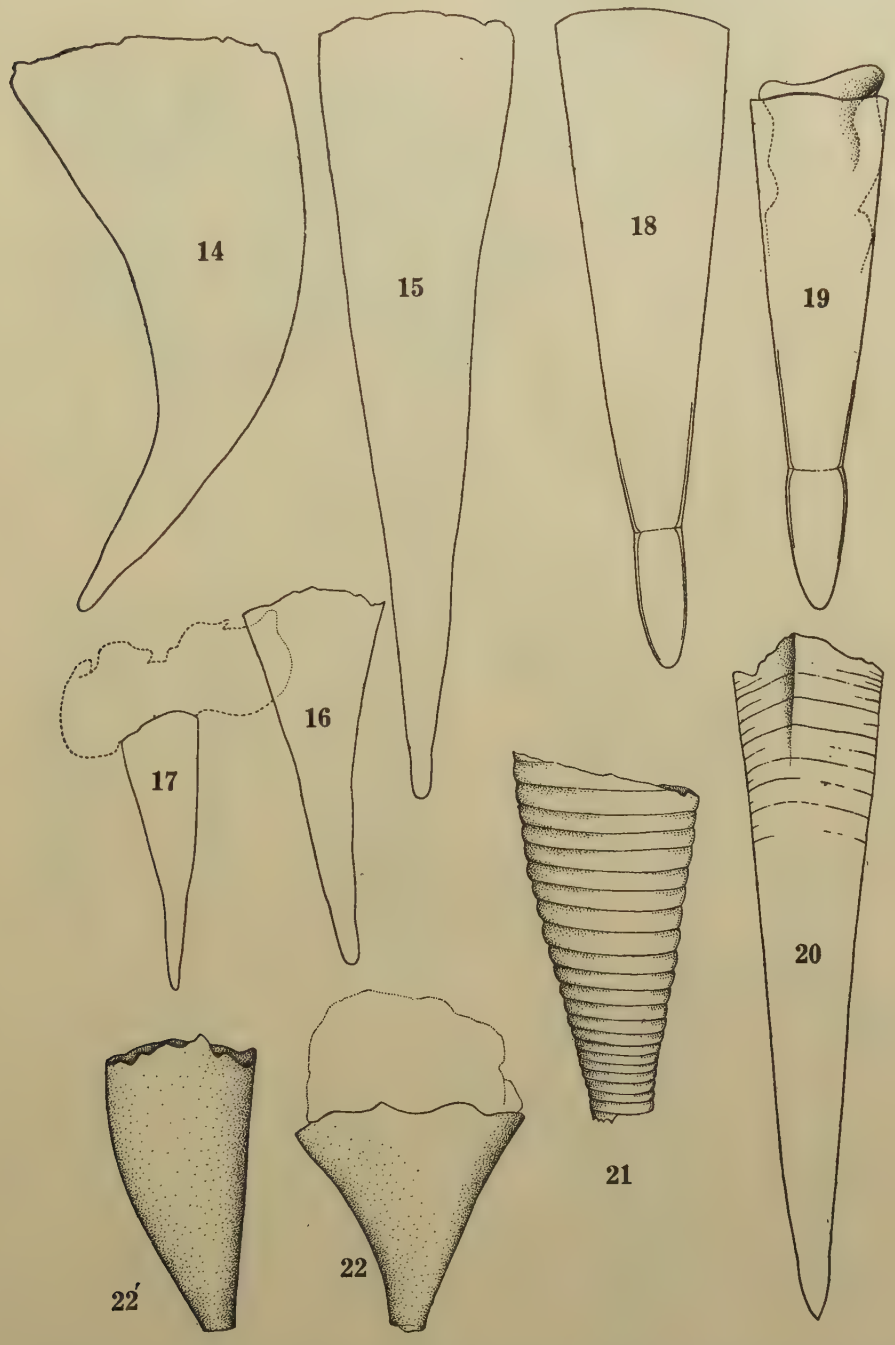

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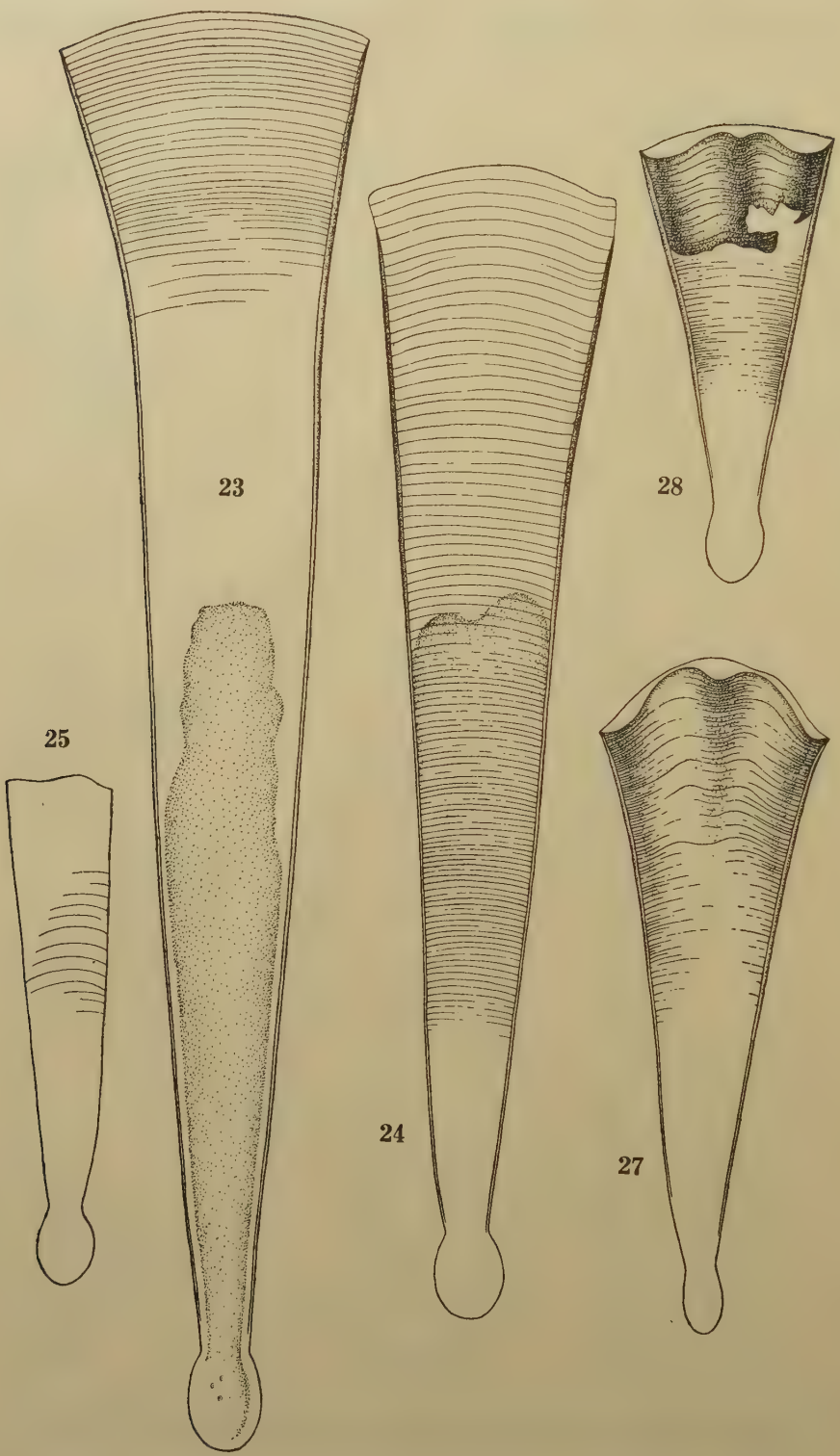

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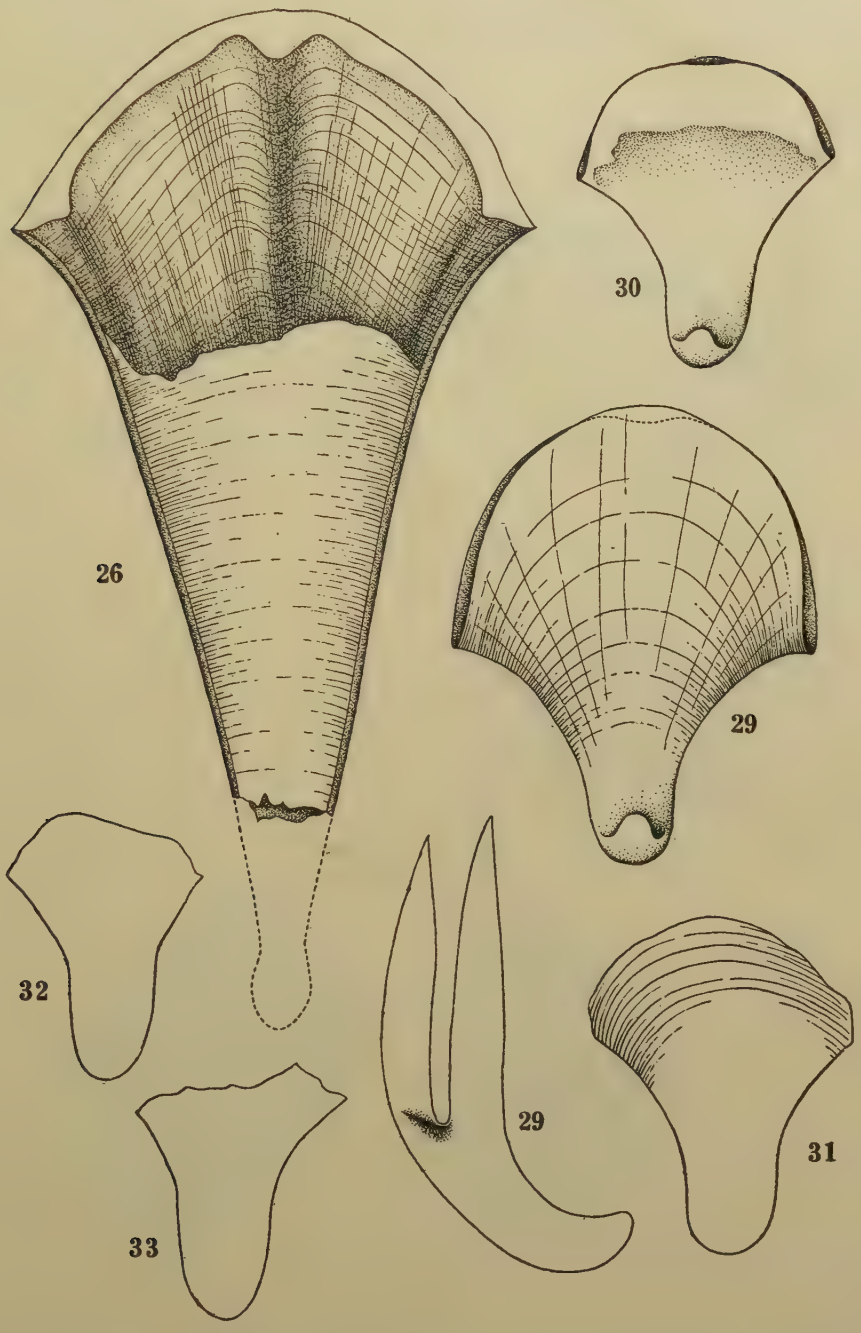

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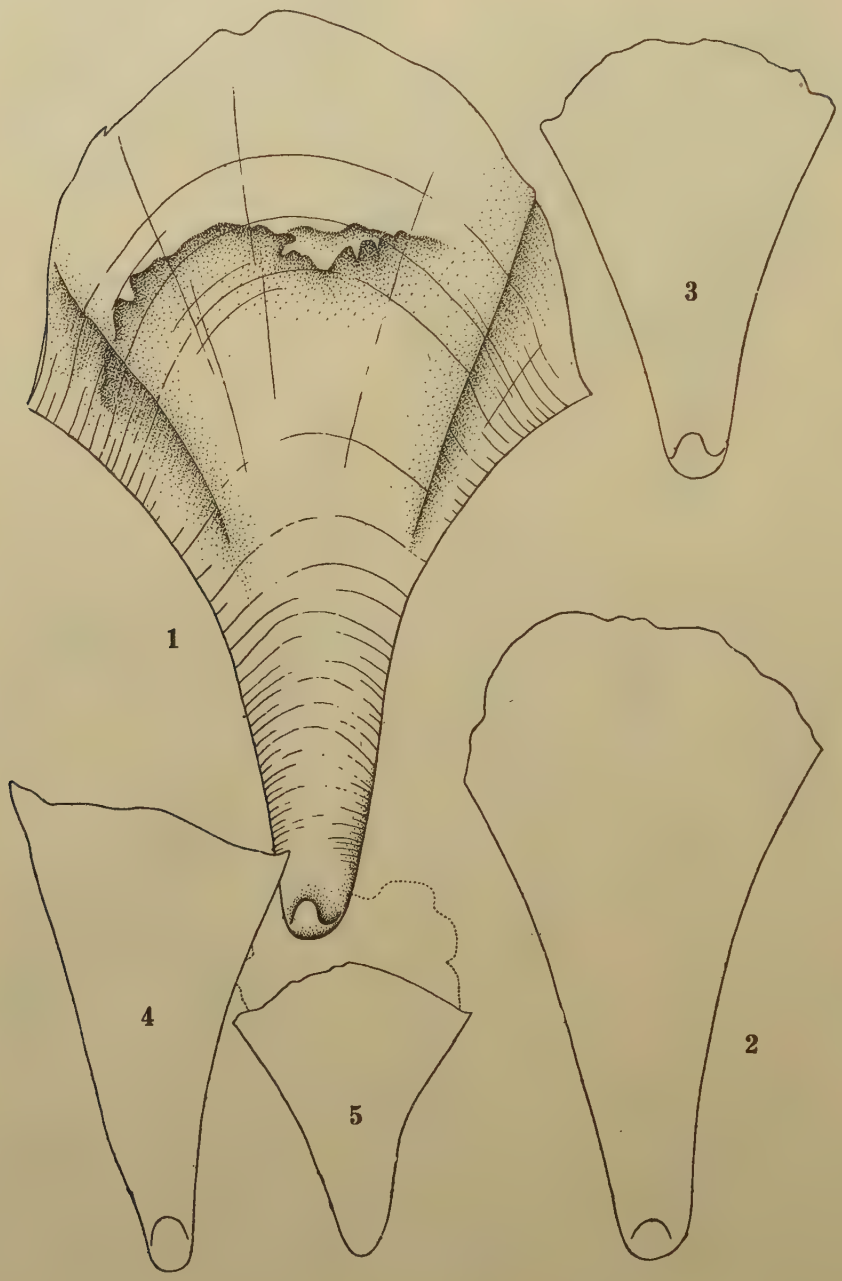

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T. Tokioka: Plankton Animals Collected by the Syunkotu-maru, IV.

TAKASI TOKIOKA

Seto Marine Biological Laboratory, Sirahama

With 5 Text-figures and 3 Tables

XVII. A Small Collection of Chaetognaths and Pelagic Tunicates from the North Eastern Part of the Indian Ocean.

(Figs. 19–21)

The present material consists of three samples respectively collected in the following localities during the exploring voyage of the Syunkotu-maru, a surveying ship of the Simonoseki College of Fisheries.

1. Near the Nicobar Islands (0–100 m), Dec. 27–28, 1953, (11–15 h); obtained by two hauls.
2. Near Nias Island (0–100 m), Jan. 2–5, 1954; obtained by three hauls.
3. Between Bali and Lombok (0–100 m), Jan. 18–22, 1954 (13–16 h); obtained by three hauls.

This contains the following 27 forms in the proportions shown below.

Table I. Cheatognaths. (Numerals in parentheses indicate the percentages.)

Species \ Locality	Nicobar	Nias	Bali-Lombok
Sagitta hexaptera	2 (3)	4 (3)	3 (2)
Sagitta enflata	20 (30)	34 (21)	55 (35)
Sagitta bipunctata	1 (2)		4 (3)
Sagitta bedoti	3 (4)	5 (3)	15 (9)
Sagitta pulchra			1 (1)
Sagitta robusta	5 (8)	3 (2)	5 (3)
Sagitta serratodentata pacifica	6 (9)	38 (24)	32 (20)
Sagitta neglecta	3 (5)	7 (4)	3 (2)
Sagitta regularis	8 (12)	34 (21)	10 (6)
Sagitta minima		1 (1)	
Pterosagitta draco	18 (27)	34 (21)	27 (17)
Krohnitta subtilis			1 (1)
Krohnitta pacifica			2 (1)
Total	66	160	158

1) Contributions from the Seto Marine Biological Laboratory, No. 270.

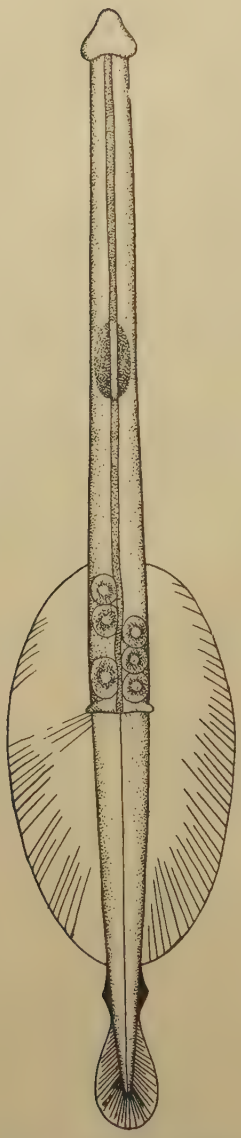

Fig. 19. *Krohnitta subtilis* (GRASSI). An individual with large mature ova. ×15

Fig. 20. *Thalia democratica* (FORSKÅL). An atrial palp. ×110

Chaetognaths: *Sag. enflata*, *Pterosag. draco* and *Sag. serratodentata pacifica* are the commonest species and next *Sag. regularis* being followed by *Sag. bedoti* and *Sag. robusta*. The single specimen of *Krohnitta subtilis* from Bali-Lombok (Fig. 19) seems to be noteworthy in having three large mature ova in each trunk-coelom; these ova are enclosed in the range between the anterior end of the lateral fin and tail septum. This individual is 9.6 mm in length, its seminal vesicles have already bursted.

Table II. Pelagic tunicates.

Species \ Locality	Nicobar	Nias	Bali–Lombok
Thalia democratica	r	1	r r
Doliolum Amme		1	
Oikopleura longicauda		4	
Oikopleura fusiformis	1	6	3
Oikopleura gracilis?		2	
Oikopleura rufescens			1
Oikopleura cophocerca	2	2	1
Stegosoma magnum		5	
Megalocercus huxleyi			1
Fritillaria haplostoma			1
Fritillaria formica	1		
Fritillaria pellucida			1
Fritillarnia borealis f. *sargassi*		1	1
Fritillaria venusta			1

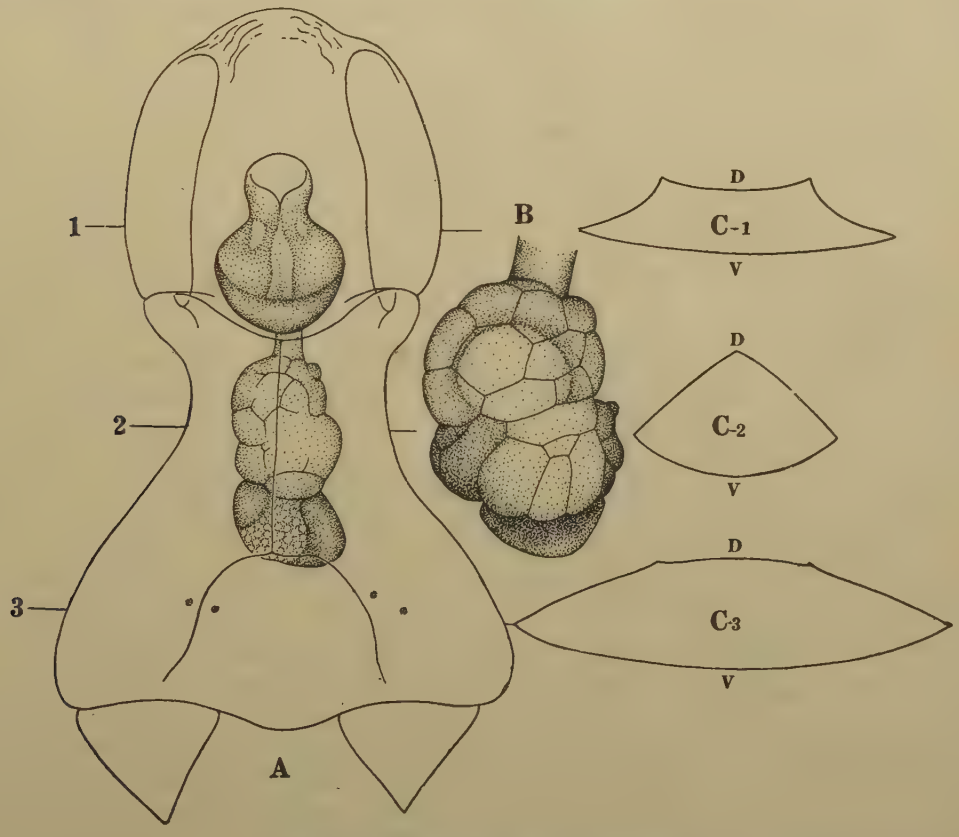

Fig. 21. *Fritillaria venusta* LOHMANN.

A—Dorsal side, ×110; B—Alimentary organ, dorsal, ×200; C_{1-3}—Three sections of the test, respectively on the levels 1 (C_1), 2 (C_2) and 3 (C_3), ×110. d—dorsal, v—ventral.

Salpas: All the solitary forms of *Thalia democratica* found in the material are provided with the atrial palp simply pointed distally and with roughly triangular section; the palps are usually furnished with minute prominences (Fig. 20).

Appendicularians: Although the single specimen of *Fritillaria venusta* from Bali-Lombok is small, about 900 μ in length of the trunk, and quite immature, it is preserved so perfectly that the shape of its soft test of the trunk may be easily understood; three sections of the test are shown in Fig. 21.

Lastly I express my hearty thanks to Prof. T. CHIBA and Mr. S. TSURUTA by whose courtesy the present material was submitted to my examination.

XVIII. Short Notes on a Few Appendicularians Collected in the "Kurosio" off Siono-misaki.

(Figs. 22 and 23)

A few appendicularian specimens were selected out of the plankton samples collected by the surveying ship of the Kôbe Marine Observatory in the "Kurosio" off Siono-misaki in May 1954 and submitted by courtesy of Mr. K. FURUHASHI of the Observatory to my close examination. This material comprises:—

Oikopleura albicans (LEUCKART)	10 individuals
Oikopleura cophocera GEGENBAUR	2 „
Stegosoma magnum (LANGERHANS)	2 „
Althoffia tumida LOHMANN, 1892	1 tail
Fritillaria fraudax LOHMANN	1 individual

Results of various measurements on these specimens are shown in the last part of this note.

Oikopleura albicans: Subchordal cells increase with growth; for instance, they are merely 28 in a 2910 μ long tail, while they may be as numerous as 77 in a 5350 μ long tail. The arrangement of cells seems to be rather irregular in smaller specimens and becomes regular with growth, being composed of two parallel rows. In the posterior part, however, the arrangement keeps a single row even in fully grown individuals (Fig. 22 D–H).

Oikopleura cophocerca: Subchordal cells are divided into anterior and posterior groups, the former comprises 4 cells and the latter consists of 3 ones (Fig. 22 J).

Stegosoma magnum: In the larger specimen, the gonad is bent sharply at the posterior end and distinctly interrupted at this point (Fig. 23 K).

Althoffia tumida: As the arrangement of numerous (59 on both sides) tail cells differs from that in *Pelagopleura*, the present tail specimen is considered to belong to *Althoffia*. The posterior end of the chorda falls considerably in front of the distal end of the musculature (Fig. 22 I).

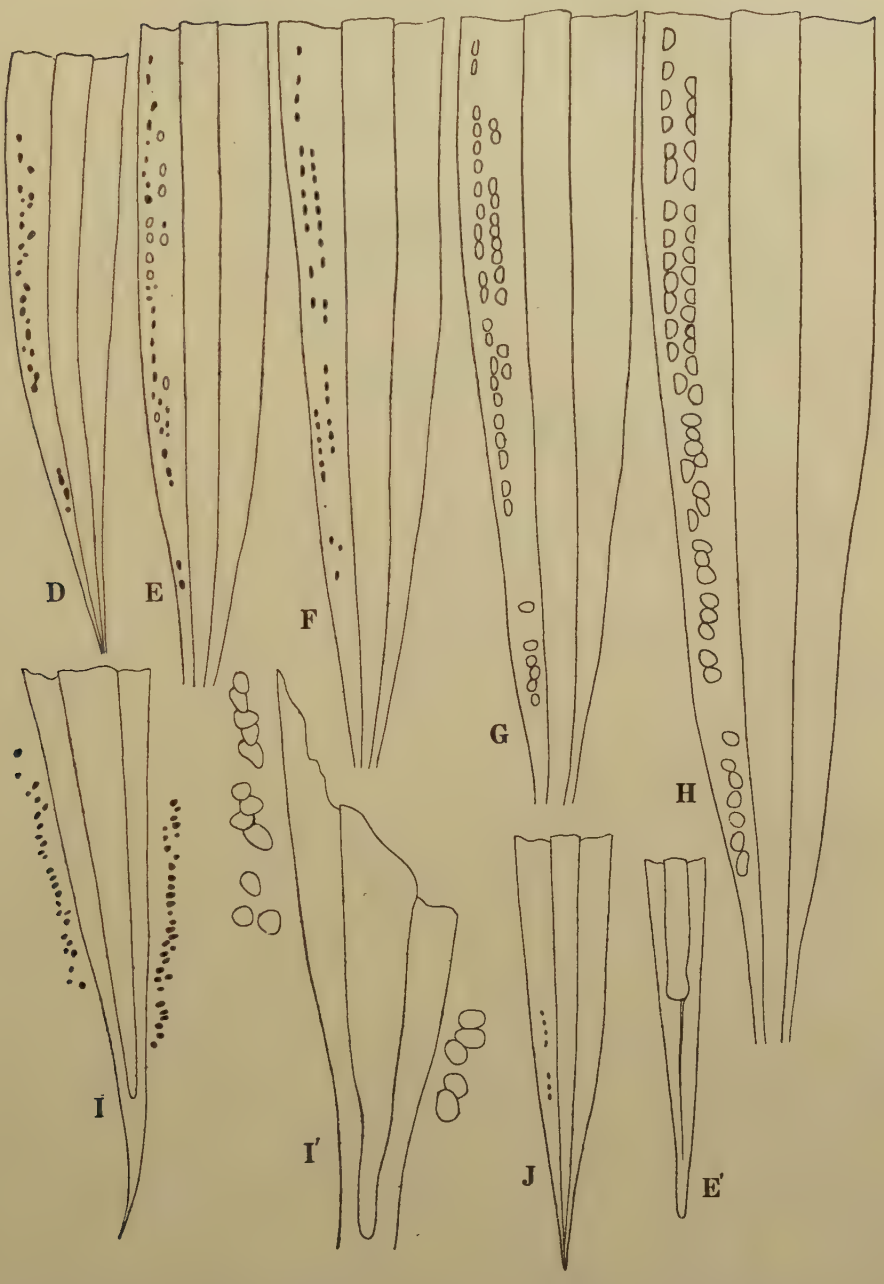

Fig. 22. D-H *Oikopleura albicans* (LEUCKART). Arrangement of subchordal cells, ×47. D—Tail length 2910μ; E—3390μ; E'—Distal end of the tail musculature, ×200; F—4650μ; G—4480μ; H—5830μ. I—*Althoffia tumida* LOHMANN. Distal part of the tail, showing the arrangement of tail cells, ×73; I'—The same, ×200. J—*Oikopleura cophocerca* GEGENBAUR. Arrangement of subchordal cells, ×47.

Fritillaria fraudax: The posterior end of the chorda does not reach the distal end of the musculature (Fig. 23 L).

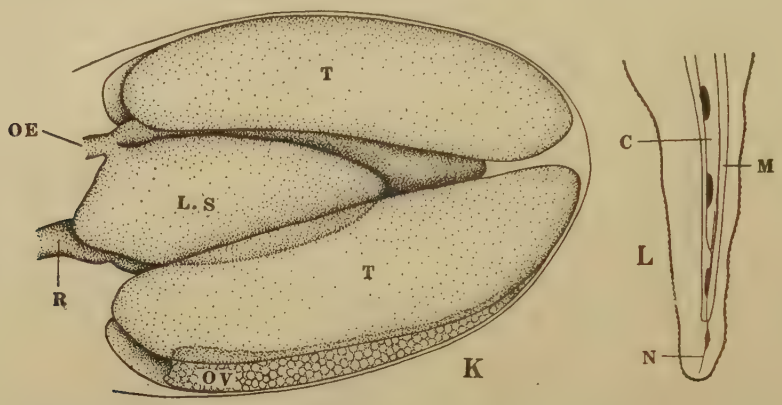

Fig. 23. K—*Stegosoma magnum* (LANGERHANS). Genital region of the trunk, left side, ×47; L—*Fritillaria fraudax* LOHMANN. Distal end of the tail, ×73. C—chorda, L.S—left stomach lobe, M—tail musculature, N—nerve, OE—oesophagus, OV—ovary, R—rectum, T—testis.

Table III. Various measurements on the material.
(C···Width of chorda, M···Width of tail musculature)

Trunk length (B)	Tail length (T)	$\frac{T}{B}$	Subchordal cells	$\frac{M}{T}\times 100$	$\frac{C}{M}\times 100$
Oikopleura albicans					
740μ	2910μ	3.9	28	11.3	34.8
930	3390	3.6	39	11.8	26.8
960	4650	4.9	36	10.1	37.9
1110	4480	4.0	40	11.2	25.7
1220	5570	4.6		10.8	29.8
1390	5830	4.2	52	11.8	26.0
1430	5350	3.7	77	11.7	28.4
1650	6260	3.8	61	11.9	28.8
1870	6650	3.6	59	10.5	35.7
1870	7300	3.9	55	12.0	30.9
Oikopleura cophocerca					
540	2780	5.1	7	10.8	23.8
	2650		7		
Stegosoma magnum					
1610	6520	4.1	8		
2000	8000	4.0	8		
Althoffia tumida					
	4220		27-32 (Tail cells)	18.1	25.0
Fritillaria fraudax					
1090	2550	2.3		7.4	32.1

MARINE INSECTS OF THE TOKARA ISLANDS

VIII. FAMILY STAPHYLINIDAE (COLEOPTERA)[1)]

KOHEI SAWADA

Biological Laboratory, Saikyô University, Kyoto

With Plates XIV and XV

This paper is based on the material obtained through the scientific expedition of Tokara Islands, off the south of the island of Kyushu, in 1953, and includes descriptions of two new genera and six new species, all belonging to the same group of the subfamily Aleocharinae.

The type specimens designated in the present paper are preserved in the collection of the Osaka Municipal Museum of Natural History, partially in our laboratory.

Before going further I express my hearty thanks to Professor Dr. T. ESAKI, Mr. M. HAYASHI, Mr. M. IGA, Professor S. MIYAMOTO, Professor T. NAKANE, Mr. K. SAKAGUCHI and Mr. S. UÉNO for their constant supporting and guidance. Also I must acknowledge the cooperation of the Museum.

Genoplectes, gen. nov.

Head large, sides subparallel; labrum transverse, arcuate and setigerous at the front margin, its lateral sides slightly divergent basally; labial palpi 3-jointed, robust, articulation between the 1st and 2nd joint obscure, with the 1st joint short, 2nd more than twice as long as 1st, scarcely constricted behind, 3rd narrower, about a half as long as 2nd; maxillae chitinous, with outer lobes broad, slightly curved inwards, distinctly ciliate at the truncate apex, not converging towards the tip, inner lobes voluminous proximally, scarcely shorter than the outer, loosely pointed and moderately incurved distally, 5 or 6 irregular setae on the inner margin; mentum transverse, strongly and deeply sinuate on the front margin, distinctly dilated basally at sides; mandibles robust, gently pointed at the apex, the right one with an acute short tooth in the middle of the inner margin, the left simple; maxillary palpi in ordinary form, the 1st joint small, 2nd large, dilated at the middle, 3rd slightly longer than 2nd, distinctly dilated distally, 4th only one-fourth as long as 3rd, subtruncate at apex; eyes small; genae obliquely grooved, with two short plicae; gular plate broad, parallel

1) Scientific Survey of the Tokara Islands, Report No. 22.

but somewhat narrowed at the middle; antennae slightly dilated distally, with the 1st joint robust and constricted behind, 2nd shorter than 1st, 3rd longer than 4th, narrower than the preceding, the rest of moniliform, 11th longer than 10th, not pointed.

Pronotum subcordate, distinctly constricted behind, apparently declivous laterally; scutellum very large, convex above.

Elytra strongly abbreviated in length, apparently convex at the middle, the suture slightly but apparently dehiscent in full length.

Abdomen distinctly dilated distally, thick; tarsal formula 4–4–4, tarsi with the first 3 joints generally short and subequal in length, 4th subequal to the basal rest but the hind one distinctly longer; prosternum broad, shortly pointed behind, meso- and metasternum very narrow; fore coxal cavities broadly opened behind, middle coxae and hind coxae strongly approximate to each other.

Genotype: *Genoplectes uenoi*, sp. nov.

This new genus resembles in habitat and general appearance *Diglotta* CHAMPION, 1887 and *Liparocephalus* MÄKLIN, 1853. But in some important characters it shows as belonging to the tribe Hygronomini. It may be near the genus *Bamona* SHARP, 1883.

Genoplectes uenoi, sp. nov.

Male. 2.2 mm. Body elongate, convex above, robust, distinctly pubescent throughout, lustrous; piceous, the distal half of the abdomen blackish, head somewhat infuscate, legs paler.

Head large, parallel but slightly dilated distally, moderately longer than broad, finely and densely punctured, mandibles relatively large and produced distally, eyes small, rather rudimentary, genae well-developed, moderately expanded laterally; antennae with the elongate 1st joint slightly bent inwards, 2nd subtruncate at the apex, 3rd apparently constricted behind, 4th as broad as long, 10th about as long as broad, 11th slightly longer than 10th, gently pointed; neck broad and short, hidden by the pronotum; pronotum seemingly longer than broad, convex, minutely shagreened above, inflexed laterally, prothoracic epipleura scarcely visible from side, the greatest width at the anterior one-third, and then, abruptly constricted behind, with sides gently sinuate before the hind angles; scutellum very large, convex, triangularly pointed behind, pubescent; elytra very short, a half as long as pronotum, suture dehiscent in full length, humeri not distinct, rather distinctly, coarsely punctured; abdomen voluminous, apparently divergent distally, three visible tergites deeply defined and impressed at the base, pygidium almost impunctate but densely punctured proximally; legs moderately long, with the robust femora, and front tibiae densely spinose, claws long, broadly separated; female unknown.

Holotype: One male, Nakanoshima (Yoriki), 4–VI–1953. Collected by Mr. S. UÉNO.

Halesthenus, gen. nov.

Body linear, rather depressed above; labrum produced distally, rounded with an additional membrane apically, mandibles short, robust, obtusely pointed, the right one with a small tooth on the basal part of the inner margin, the left simple, maxillae with the outer lobes shorter than the inner lobes, fully thin and corneous, nearly straight, slightly incurved at the extreme distal part, the inner lobes elongate, only weakly incurved at the apex, more chitinous than that of the outer one, on the distal half bearing 5 or 6 minute dentations, and 5 additional long hairs at the proximal rest, mentum transverse, broadly and deeply excised at the front margin, ligula short, membraneous, entire, subtruncate at the front margin, maxillary palpus 4-jointed, the 1st joint small, triangular, 2nd subequal to 3rd, moderately incrassate at the middle, 3rd also incrassate anteriorly, the last one small, labial palpus bristle-like, 2-jointed, but the articulation between 1st and 2nd joint indistinct, the 1st joint elongate, twice as long as 2nd, with a small, appendage at the tip of 2nd, infra-orbital carina vanishing; prothoracic epipleura more or less visible from the side, prosternum obtusely angulate posteriorly, mesosternal process elongate, more or less pointed, front coxae moderately separated, middle one fully approaching basally; tarsal formula 4-4-5, fore and middle tarsi with the first 3 joints short and subequal in length, the last one longer than the predecessor, hind tarsi with the 1st joint as long as 5th, 2nd to 4th short and subequal in length; antennae elongate, each joint not transverse, not incrassate distally, with the 1st joint robust, 2nd subequal to 1st, 11th usually longer than the preceding, lightly pointed.

Genotype: *Halesthenus minutus*, sp. nov.

The characteristics of the genus described here are similar to those of *Bryobiota* CASEY, 1893, in general, but the genus is different from it mainly by the form of maxillae, especially elongate labial palpus.

Key to the species

1. Body small (1.5 mm), eyes rudimentary. ..... *minutus*, sp. nov.
   Body large (more than 2.2 mm), eyes normal. ..... 2.
2. 3rd joint of maxillary palpus not cylindrical and broadly hollowed at the middle of outer surface, 4th joint broad and very short. ..... *tsutsuii*, sp. nov.
   3rd joint more or less cylindrical and not hollowed, 4th joint normally formed. ..... 3.
3. Body weakly chitinized, pale yellowish in colour, eyes of moderate size.... *serpentis*, sp. nov.
   Body distinctly chitinized, brownish to blackish in colour, eyes large. ..... *nakanei*, sp. nov.

Halesthenus minutus, sp. nov.

Male. 1.6 mm. Body linear, depressed above; dull in lustre; pale yellowish brown, legs and antennae somewhat paler.

Head orbicular, as broad as pronotum, slightly produced distally, gently convex above, punctures obscure, rather alutaceous, mandibles relatively large, labial palpi sur-

passing the top of mandibles, maxillary palpi rather large, eyes rudimentary, gular plate broad, moderately widened behind; antennae slender, apparently attaining to the base of elytra, the 1st joint large, slightly thickened at the middle, 2nd slightly shorter than the preceding one, but more cylindrical, 3rd of egg-cup-shaped, distinctly constricted proximally, 4th to 10th gradually increasing in length, 11th subequal to 10th and 9th conjointly, gently pointed; pronotum quadrate, nearly deplanate on disc, narrowly inflexed laterally, the front angles not rounded, with a short fixed seta, sides almost straight, only invisibly sinuate before the posterior angles which are loosely angulate; elytra subequal to the pronotum in length and breadth, plain; without distinct punctures; apterous; abdomen subparallel, feebly divergent posteriorly, slightly broader than the elytra, finely, densely pubescent and rather finely punctured, legs slender, claws minute, simple.

Holo-, allo- and paratypes: One male and three females. Nakanoshima (Yoriki), 4–VI–1953. Collected by Mr. S. Uéno.

Halesthenus tsutsuii, sp. nov.

Male. 2.7 mm. Piceous, distal half of the abdomen infuscate, visible 4th segment especially blackish, finely and distinctly pubescent throughout.

Head rather depressed above, alutaceous, broader than that of *minutus* comparatively, eyes small, not prominent with coarse facets; antennae of *minutus*, but 4th joint not so strongly constricted basally and 11th more slender and more acutely pointed; maxillary palpus with the 1st joint minute, 2nd elongate, not cylindrical, flexed and curved inwards, 3rd dilated distally, with obliquely truncate apex, and apical margin finely pubescent, shallowly but broadly concave on the external surface of the widened middle part, 4th very short and broad, abruptly truncate at the apex; pronotum as in *minutus*, but seemingly broader and more distinctly convergent backwards, disc with a slight excavation basally, the hind margin, including the basal half of sides, bordered with a narrowly reflected edge, alutaceous; elytra plain, sculptured as in pronotum; abdomen finely and densely punctured; legs rather slender.

Holotype and allotype: Takarajima, 29–V–1953. Collected by Professor S. Miyamoto.

In General appearance this species is notably allied to *H. minutus*, but easily separable from it by the much larger size of the body and the otherwise formed maxillary palpus, etc.

Halesthenus serpentis, sp. nov.

Female. 2.6 m. Of the facies of *H. tsutsuii* greatly, but the body narrower and the pronotum more quadrate. Antennae with the last joint shorter and broader than that of *tsutsuii*, the maxillary palpus of the ordinary form as in *minutus*, the 3rd joint

not hollowed internally, similarly punctured as the preceding, but finer and denser, and abdomen impunctate, rather reticulate or leather-like.

Holotype and two paratypes: Nakanoshima (Amadomari), 9–VI–1953. Collected by Mr. S. Uéno.

Halesthenus nakanei, sp. nov.

Male. 2.2 mm. Body elongate, subparallel-sided, well-chitinized; weakly polished; head and pronotum brown, elytra becoming yellow towards the extremity, abdomen fuscous, but the extreme distal region paler, head, pronotum and elytra finely alutaceous.

Head orbicular, seemingly transverse, gently convex, finely pubescent above, eyes well-developed, larger than that of *tsutsuii* and *serpentis*, prominent with rough facets, mandibles robust, produced distally, the right one with a small tooth basally, labial palpi elongate, evidently produced beyond the top of the mandibles as in other relatives, infraorbital plica vanishing, maxillary palpus with the 2nd joint moderately widened distally, without flexion and curve, broadly hollowed at the inner surface but not so abruptly as in *tsutsuii*, antennae rather short, slender, scarcely thickened towards the apex, the scape slightly longer than the 2nd, 3rd longer than 4th, 10th feebly transverse, 11th shorter than 10th and 9th combined. Pronotum apparently transverse (14 : 11), moderately convex, acutely, strongly inflexed laterally, with the greatest width at the apical one-third, being gently narrowed anteriorly and the basal rest abruptly convergent backwards, the front angles indistinct, the hind ones rather distinct because of the feeble sinuation set just before them, a fine sulcus running along the front margin at a short distance. Elytra apparently longer (15 : 11), and slightly broader, than the pronotum. Abdomen rather coriaceous, moderately impressed at the base of each tergite, furnished with long yellowish hairs laterally. Mesosternal process sharply pointed behind. Tarsi of the likeness of *tsutsuii* and *serpentis*.

Holotype: Takarajima, 29–V–1953. Collected by Mr. S. Uéno.

There are some notable characteristics in the new species as follows:

1. The integument of the body being chitinous conspicuously,
2. strongly infuscate coloration in general, and
3. an abrupt constriction of the pronotum.

Thus easily distinguishable from the preceding by the visible characters above-mentioned.

Ischnopoda (*Stethusa*) *miyamotoi*, sp. nov.

Female. 2.2 mm. Body testaceous, head, meso- and metasternum, and abdomen more or less infuscate; polished; distinctly pubescent throughout.

Head orbicular, comparatively small, seemingly narrower than pronotum, densely and distinctly punctured, vertex slightly concave longitudinally, hind angles narrowly

rounded, hind margin rather abrupt, genae not margined, eyes small, feebly prominent, labrum distinct, subquadrately produced distally, with front angles rounded, and nearly straight at the front magin, the right mandible with a tooth just behind middle of the inner margin; maxillary palpi ordinarily formed, its last subulate joint subtruncate at apex, only one-third as long as 3rd; antennae slender, scarcely divergent distally, the scape feebly incrassate to the extremity, sides slightly outcurved, 2nd joint shorter and narrower than 1st, 3rd again shorter than 2nd, abruptly constricted basally, 4th not transverse, 6th to 10th gradually increasing in breadth, 11th conic, shorter than 10th and 9th conjointly, all of joints armed with some blackish hairs. Pronotum subcordiform, scarcely transverse, punctured more finely and densely than the head, margin apparently inflexed below with a rounded edge, sides nearly straight with a weak sinuation behind middle, front margin apparently oblique on both sides, disc moderately sulcate longitudinally, scutellum unnoticed. Elytra punctured as in head, but more sparsely and coarsely, slightly broader and apparently longer than pronotum, rather depressed above, humeri slightly prominent. Abdomen highly polished, thicker, feebly divergent distally, first three visible tergites deeply depressed basally, apparently and coarsely punctured. Legs slender, with elongate femora, hind tarsi with the 1st joint subequal to 2nd and 3rd conjointly, prosternum broadly occupying, shortly angulate behind, mesosternal process rather prolonged, and acutely pointed.

Holotype: Nakanoshima (Amadomari), 6-VI-1953. Collected by Mr. S. UÉNO.

This elegant species somewhat resembles in facies *I. transfuga* SHARP, 1874, but is radically separated from it by the articulation of antennae, coloration of the body, and by other points.

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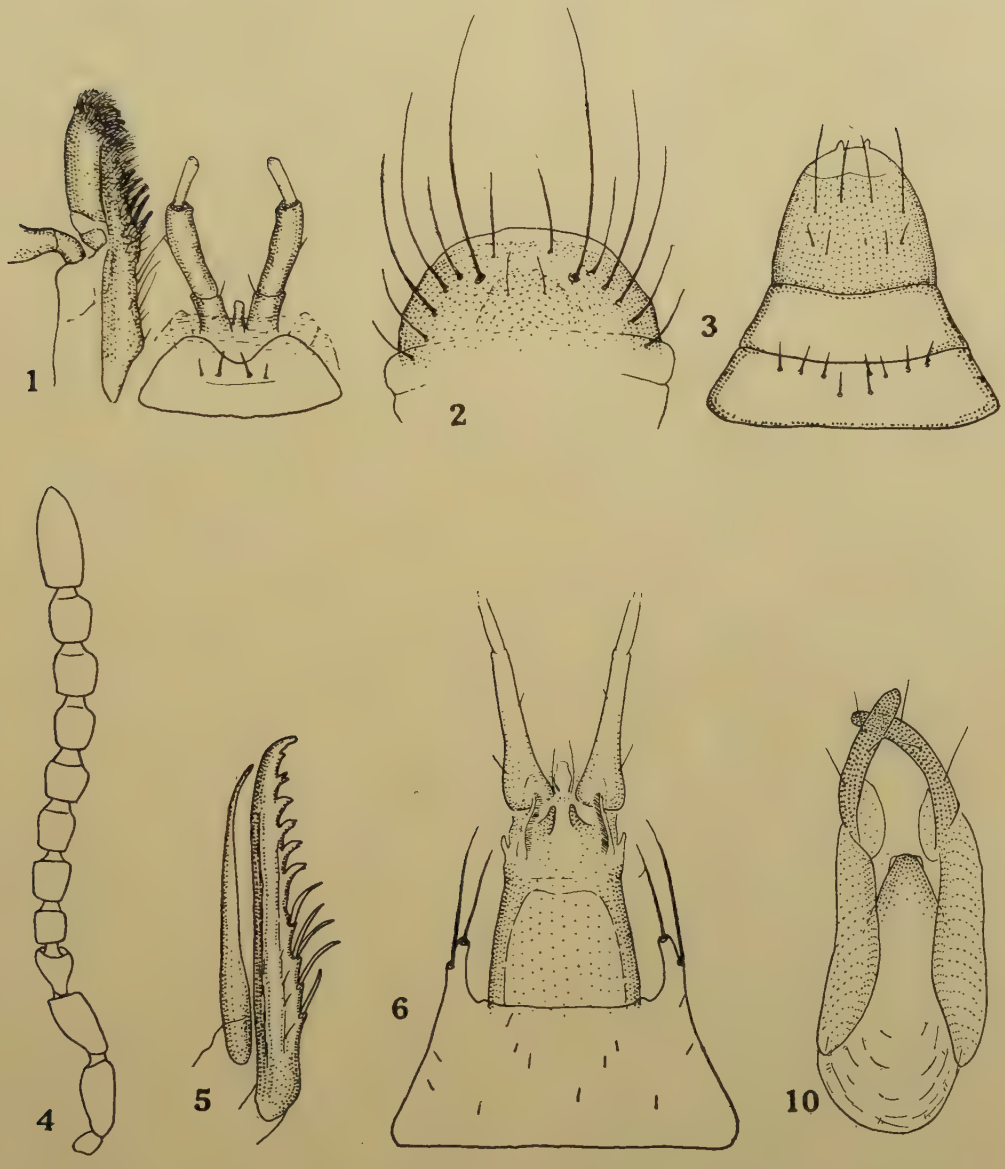
EXPLANATION OF PLATES XIV–XV

Fig. 1.	*Genoplectes uenoi*, sp. nov.	Maxilla and labium.	×145
Fig. 2.	„	Labrum.	×278
Fig. 3.	*Halesthenus minutus*, sp. nov.	Clypeus and labrum.	×282
Fig. 4.	„	Antenna. Pubescence not shown.	×145
Fig. 5.	„	Maxilla.	×289
Fig. 6.	„	Labium.	×298
Fig. 7.	„	3rd and 4th joint of maxillary palpus.	×380
Fig. 8.	*Halesthenus tsutsuii*, sp. nov.	„	×180
Fig. 9.	*Halesthenus nakanei*, sp. nov.	„	×175
Fig. 10.	*Halesthenus tsutsuii*, sp. nov.	Aedeagus. Ventral view.	×142



K. Sawada: Marine Insects of the Tokara Islands, VIII.

Genoplectes uenoi, g. nov., sp. nov.

Ischnopoda (*Stethusa*) *miyamotoi*, sp. nov.

Halesthenus nakanei, g. nov., sp. nov.

K. Sawada: Marine Insects of the Tokara Islands, VIII.

CARBONIC ANHYDRASE IN PEARL OYSTER

II. CHANGES OF THE ENZYME ACTIVITY IN RELATION TO GROWTH AND SEASONS[1)]

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With 3 Text-figures

Introduction

The problem of shell formation in molluscs has hitherto been studied by many investigators, and most of their works were reviewed comprehensively by Robertson (1941). It is now generally conceded that the process of shell formation follows three distinct steps: 1) absorption of calcareous materials into organism, 2) secretion of the shell material from mantle epidermis, 3) transformation of the secreted material to the crystal of calcium carbonate and the organic matrix or the conchiolin which cements the crystal. Recent experiments with radioisotope have shown that the calcium ion in the water is directly absorbed and utilized in shell formation (Bevelander, 1952; Wilbur and Jodrey, 1952; Abe *et al.*, 1954; Tanaka and Hatano, 1955).

Although the origin of carbonate radical in shell component is still obscure, a view suggested by Robertson (1941), that metabolic carbon dioxide will be the primary source of the carbonate, may be the most practical one. Furthermore, it is considered that some enzymes, which regulate the production of carbon dioxide and the concentration of bicarbonate and carbonate ion, will play an integral role in the enzymatic system of shell formation. Carbonic anhydrase is one of these enzymes. In the first paper of this series (Kawai, 1954), it was shown that a considerable amount of the enzyme was present in the tissues of gill on mantle edge. The purpose of the present study is to find out the relationship between the ability of shell formation and carbonic anhydrase activity in this bivalve.

Materials and Methods

The specimens of the cultured pearl oyster (*Pinctada martensii*) were obtained from the farm of Nippon Pearl Co. at Shima Peninsula, Mie Prefecture. The age of

1) Reports of Nippon Institute for Scientific Research on Pearls, No. 47.

the specimens was estimated from the settling period of the larvae to spat collector and the shell size (KOBAYASHI and TOBATA, 1949; YAMAGUCHI, 1949).

Carbonic anhydrase activity was determined by the rapid manometric method of CLARK and PERRIN (1951) at 10°C., and MELDRUM-ROUGHTON unit of the enzyme activity was adopted. The concentration of the enzyme solution in a reaction vessel was kept within the range that there was a linear relation between the added amount of the enzyme and observed catalytic effect. After grinding the tissues with a small amount of quartz sand, they were extracted with distilled water in the proportion of 1 ml to each 25 mg of tissue. Other detailed procedure is referred to a previous paper (KAWAI, 1954).

Results

Growth and enzyme activity.

The relationship between the enzyme activity of various tissues and the shell growth of pearl oyster is summarized in Figs. 1 and 2. The former result was obtained from materials collected in the middle of June, 1953, and the latter from individuals collected in late October, 1954.

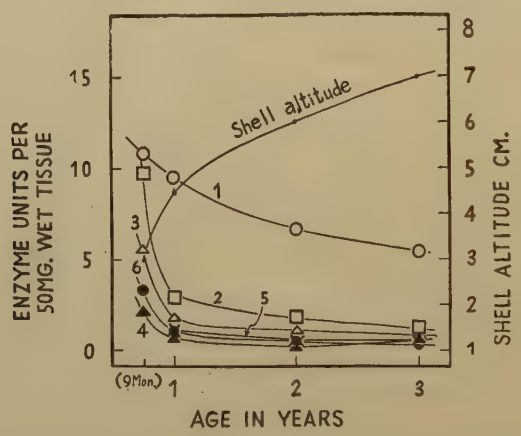

Fig. 1. The relation between carbonic anhydrase activity and shell growth. Materials were collected in June, 1953. The youngest individuals have hatched in early September of last year. Each value is the mean of five to eight individuals. 1. Gill; 2. mantle edge; 3. outer epidermis of mantle (this tissue adheres to inner surface of shell); 4. digestive diverticula; 5. gonad; 6. adductor muscle.

On all kinds of tissues the highest enzyme activity was found in that of the youngest individual several months after hatching, and its activity was from two to fifteen times that of older ones. Also the enzyme activity per unit weight in various tissues diminished gradually with reduction of the rate of shell growth. These results resemble the result observed in the mantle of oyster (WILBUR and ANDERSON, 1950).

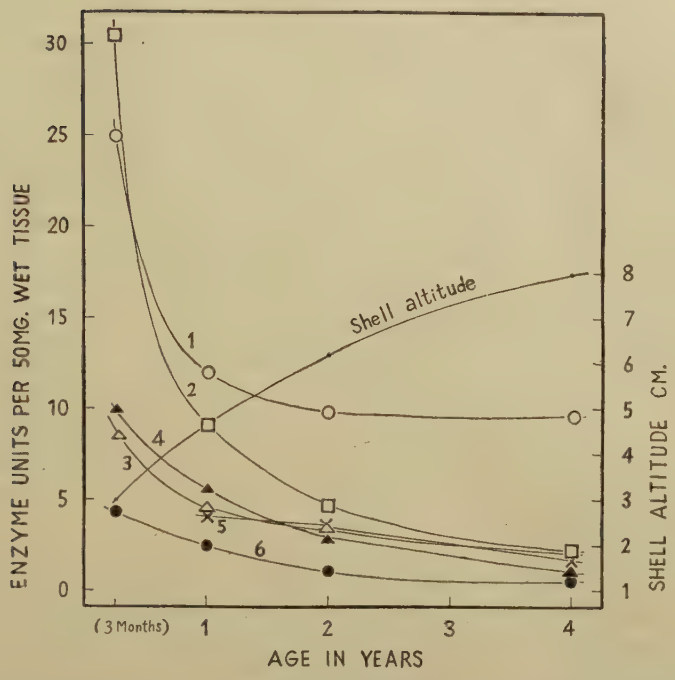

Fig. 2. The relation between carbonic anhydrase activity and shell growth. Materials were collected in October 1954. The youngest bodies have hatched in early August of this year. 1. Gill; 2. mantle edge; 3. outer epidermis of mantle; 4. digestive diverticula; 5. gonad; 6. adductor muscle.

The enzyme activity of gill and mantle edge has shown fairly higher activity than that of the other tissues throughout all individuals. The enzyme activity changes with the transition of seasons, as will be described in the next, but there is no alteration in the general tendency, that the enzyme activity per unit weight diminishes with advancing age, all the year round.

Season and enzyme activity.

The seasonal changes of marine conditions are quite extensive in the bays where pearl oyster farms are located, and these environmental changes may affect considerably the shell formation and other physiological function of pearl oyster. Several observations were made to know, how the seasonal changes of environmental condition affected carbonic anhydrase activity of various tissues on the specimens of different ages, i.e., several months after hatching, two-year-old and three-year-old. Fig. 3 shows the result of these observations. All the materials were collected in Matoya Bay in Shima district of Mie Prefecture, except those of March which were collected in Ago Bay near Matoya Bay.

There are considerable variation in the enzyme activity throughout the seasons. It seems that the enzyme activity is low in winter and high in summer and autumn. As

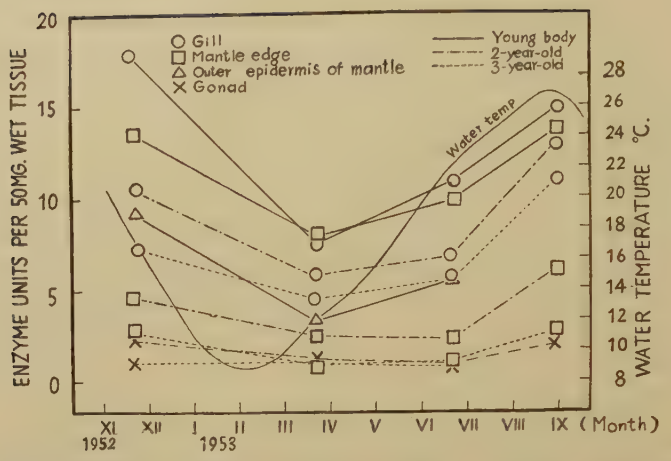

Fig. 3. Seasonal variation of carbonic anhydrase activity. Each value is the mean of five to eight individuals. The curve of water temperature represents the records at two meter depth in Matoya Bay.[1)]

was shown by KOBAYASHI and TOBATA (1949), the growth of pearl oyster is not uniform throughout the year, being rapid from May to November, and slow or stopped entirely from November to May. The water temperature of Matoya Bay rose to 22°C in June,[1)] and the enzyme activity of the youngest, having a little gonad and not yet performing the reproductive function in this year, began to increase (Fig. 3). In contrast with the youngest animal, the enzyme activity of two- or three-year-old one with fully matured gonad showed nearly the winter level in this period. It seems that the enzyme activity of the older organisms begins to increase after the spawning.[2)]

Discussion and Conclusion

It is very probable that carbonic anhydrase activity of various tissues changes markedly with the change of internal and external conditions of pearl oyster. On the relationship between carbonic anhydrase and shell formation, WILBUR and ANDERSON (1950) and GUTOWSKA and MITCHELL (1945) have made interesting observations. The former authors have shown that carbonic anhydrase activity of *Busycon* larvae increased markedly at the early stage of shell formation. The latter authors have reported that good layers, producing normal, smooth-shelled eggs, had a carbonic anhydrase activity in their shell gland of over three times that of non-layers and poor layers laying only soft-shelled eggs.

1) The author wishes to record his thanks to Mr. T. Sato, Director of Matoya Oyster Laboratory, who informed him the records of the water temperature in Matoya Bay.

2) In nature, pearl oyster begins to spawn when the water temperature reaches to 25°C. The spawning normally occurs in late June or early July and usually completes in late August.

In pearl oyster, it was found that carbonic anhydrase activity of various tissues was very low in some individuals (Table 1), which had no small scaly process at the shell edge because of ceasing the shell growth. Although the radical cause on the ceasing of the shell formation is not yet well known, it may be due to general debility of the bodies, in which the outer epidermis of mantle appears to be transparent owing to the disappearance of glycogen layer.[1)]

Table 1. Carbonic anhydrase activity of various tissues of pearl oyster related to productivity of the scaly process at the shell edge.

	Enzyme unit per 50 mg wet tissue	
	Normal bodies	Abnormal bodies
Gill	10.6	5.9
Mantle edge	4.5	1.7
Outer epidermis of mantle	1.7	1.3
Gonad	2.9	2.1
Digestive diverticula	2.5	1.7
Adductor muscle	0.3	trace

Normal bodies have a large number of small scaly process at the shell edge, but abnormals haven't such scaly process. Materials were collected in November, 1952. The age was about two-year-old. Each value is the mean of 10 individuals.

It is of interest that such reduction of the enzyme activity occurs conspicuously in the tissues of mantle edge, as nearly one-third of that in normal bodies, which will play an important role in shell formation.

It seems that the alteration of carbonic anhydrase activity with advancing ages is proportional to the ability of shell formation. This reduction of the enzyme activity with age may be regarded as a sort of biochemical senility. However, we must consider furthermore that the change may be due to relative increase of the cell not directly involving the enzyme, as previously pointed out by WILBUR and ANDERSON (1950) on the mantle of oyster.

Although the physiological function of the gill in this bivalve is not clear, it is assumed that the ciliated tissue performes both respiratory function and absorption of the salt in the water, because a large amount of carbonic anhydrase is present in the tissue and it actively absorbes the calcium ion in the water (TANAKA and HATANO, 1955).

As is shown in Fig. 3, the enzyme activity changes with season and reproductive function. The variation of the enzyme activity seems to correspond with the rate of shell growth (KOBAYASHI and TOBATA, 1949) and secreting ability of byssus changing with seasons (KOBAYASHI, 1951). From the present results, it can be concluded that carbonic anhydrase activity of pearl oyster is regulated by the internal and external factors of the organism, and that the enzyme activity is closely related to the activity of shell formation.

1) In normal bodies, this outer epidermis is white and reserves large amount of glycogen (ASHIKAGA, 1949).

Summary

1. Carbonic anhydrase activity of various tissues of pearl oyster (*Pinctada martensii*) changes markedly with transition of various internal and environmental factors of the organism, such as growth, reproductive function and seasons.

2. In all tissues, the highest activity is found in the youngest individuals several months after hatching, and the enzyme activity reduces gradually with advancing age.

3. As to seasonal variations, the enzyme activity is generally low in winter season and increases during the period from summer to autumn.

5. In just prior to the spawning, the enzyme activity of two- or three-year-old individuals with fully matured gonad shows nearly winter level, but that of several months old having a little gonad and no spawning in this year, shows already a considerable increase.

The author is greatly indebted to Prof. D. MIYADI, Lecturer K. ONO of Kyoto University and Dr. Y. MATSUI, Director of Nippon Institute for Scientific Research on Pearls for their cordial help and valuable advices. He also wishes to acknowledge his thanks to Mr. K. ISOWA of Nippon Pearl Co. for providing materials in experiments.

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A REVISION OF THE DRAGONETS REFERABLE TO THE GENUS *CALLIONYMUS* FOUND IN THE WATERS OF JAPAN

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With 12 Tables and 19 Text-figures

The fishes of the genus *Callionymus*, in which the genus *Calliurichthys* is synonymized in the present paper, are generally found on sandy or muddy shores in most of the tropical and temperate regions of the world, most plentifully in the Indo-Pacific region. They are very common in our waters and caught rather abundantly together with other shore fishes mainly for the domestic consumption and local sale.

The first actual revision of the Japanese fishes of this group was made in 1902 by Jordan and Fowler, who placed eleven species in two genera, *Callionymus* and *Calliurichthys*. The genus *Calliurichthys* was erected by them for the accomodation of *Callionymus japonicus*, *C. variegatus* and their new species, *C. doryssus*, and it is distinguished from the genus *Callionymus* in having a preopercular spine simple, sharp, spear-like and a serrated edge, instead of being recurved at the tip, and armed with one or more recurved hooks above. Some remarks on this group have since been added by Jordan and Hubbs (1925 : 317), Boeseman (1947 : 130–134) and others. In all, about twenty species of this group have been described from our waters. It appears, however, that the taxonomical studies of them that have hitherto been made are far from being satisfactorily understood since they vary externally so much according to sex, growth stage and even individuality, although they have long been of interest to some ichthyologists. In addition to this fact the present authors failed to find the significant morphological differences between these two genera, *Callionymus* and *Calliurichthys*, and accordingly prefer the older name.

The subject of this study is to determine the valid species of this group and to evaluate the extent of modification in the form and color pattern of the body due to sex and growth.

By examining a great deal of the Japanese specimens of this genus, the present authors recognized sixteen species as valid in Japan, including one which is described as new to science, and two which are reported as new to the fauna of our waters. Unfortunately no specimens of *C. variegatus*, *C. calliste*, *C. valenciennesi* and *C. kita-*

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harai have come under our examination. The original description of these species are abridged in this paper.

In the present work, the head length is indicated by a measurement from the tip of the lower jaw to the anterior margin of the gill-opening; the body width and depth are measured at the base of the first dorsal soft ray; the pectoral fin length is the distance from the middle part of the base to the tip of the fin; the pelvic fin length is recorded as a distance between the base of the pelvic fin and the tip of the fin. The coloration of the body and fins is described by the specimens deposited in formalin.

The writers of this paper wish to express their sincere gratitude to Prof. Kiyomatsu Matsubara, for his kind supervision during the course of this study. We also thank to Tatsuji Ueno (Faculty of Fisheries, Hokkaido University), Masahiko Takeda (Faculty of Agriculture, Kôchi University), Toshiharu Konada, Tamotsu Iwai and Hirotoshi Asano (Department of Fisheries, Faculty of Agriculture, Kyôto University), who sent us a number of valuable specimens of this group. The expense for executing the work of present study is defrayed from the research fund offered by the Ministry of Education from 1953 to 1954.

Key to the Japanese species of *Callionymus*

1a. Opercular spine sharp, straight, saber-like, the upper margin finely serrated.
  2a. 2 bony striated patches on top of occipital region, separated with each other; dorsal and anal soft rays 9 and 8 respectively; 1st dorsal ocellated with a large jet black blotch between 3rd and 4th spines; in male, anterior 2 dorsal spines elongated and filamentous, and chest with a black blotch.....*C. japonicus* Houttuyn
  Syn. *C. numeri* Tanaka
  2b. A broad rugosely striated bony patch on top of occipital region; dorsal and anal soft rays 8 and 7 respectively; 1st dorsal not ocellated with black; in male, anterior 2 dorsal spines elongated and filamentous; a blackish blotch on the chest and 1 or 2 black ocelli on the flanks .....*C. variegatus* Temminck et Schlegel
  2c. Upper surface of head entirely smooth; both dorsal and anal with 9 soft rays; 1st dorsal not ocellated with black; dorsal spines all produced into filaments except for young; in male, under side of head uniformly pale ...*C. doryssus* (Jordan et Fowler)
1b. Preopercular spine recurved at the tip, the upper margin armed with 3 or more recurved hooks.
  3a. Dorsal soft rays 8; anal soft rays 7; lateral line not connected by a branch with a fellows of opposite side on upper surface of caudal peduncle.
    4a. Eye smaller, about 1/4 as long as head; in male, dorsal spines long and filamentous, anal greyish white except for blackish margin; in female, dorsal spines not filamentous, anal uniformly yellowish.....*C. calliste* Jordan et Fowler
    4b. Eye larger, about 1/3 as long as head; in male, dorsal spines all prolonged into Filaments, the fin membrane black with some whitish zig-zag lines; in female, dorsal spines all completely connected by membrane, the fin membranes black except for anterior part.....*C. phasis* Günther

3b. Dorsal and anal each usually with 9 soft rays; lateral line connected by a branch with a fellow of opposite side on upper surface of caudal peduncle.

5a. Preopercular spine rather thick, with 5 or 6 sharp hooks on the upper margin; head flattish, wider than long; in male, 1st dorsal pale, vermiculated with black; in female, the fin uniformly black.....*C. planus* sp. nov.

5b. Preopercular spine rather slender, with 3 or 4 sharp hooks on the upper margin; head moderately depressed, as wide as or narrower than long.

6a. Hindmost hook on preopercular spine barbed (Fig. 6); 2 median caudal rays more or less produced into filaments.

7a. Dorsal soft rays all produced, much longer than head; in male, 1st dorsal grey, with 3 dark bands running obliquely, and dotted with an irregular black spot between 3rd and 4th spines.....*C. sokonumeri* KAMOHARA

7b. Dorsal soft rays moderately long, as long as head; 1st dorsal with a blackish blotch between 3rd and 4th spines; in male, 2 median caudal rays especially elongated .....*C. kaianus* GÜNTHER

6b. Hindmost hook on preopercular spine not barbed; caudal rays either short or more than 2 rays produced.

8a. Urinogenital papilla elongated (male).

9a. Several median caudal rays elongated into filaments; dorsal spines greatly produced into long filaments except for 2nd spine .....*C. flagris* JORDAN et FOWLER

9b. Caudal fin not produced into filaments.

10a. Dorsal spines not produced into filaments; sides of body crossed by numerous narrow oblique lines of light brown; outer margin of 1st dorsal with a narrow black blotch of crescentic shape .....*C. punctatus* LANGSDORFF
Syn. *C. richardsoni* BLEEKER

10b. All or some of the dorsal spines produced into filaments, sides of body not crossed by narrow oblique lines.

11a. 1st dorsal spine elongated into long filaments, but other spines not especially elongated; a blackish ocellus behind the last dorsal spine .....*C. lunatus* TEMMINCK et SCHLEGEL

11b. Dorsal spines more or less produced into filaments.

12a. 1st dorsal spine the longest, the fin plain; anal edged with black .....*C. huguenii* BLEEKER

12b. Anterior 2 dorsal spines longer than others; eye as large as or less than snout.

13a. 3 median rays of caudal longer than others; last dorsal and anal rays extending beyond base of caudal; 1st dorsal without large black spots; anal pale or black with numerous oblique wavy white lines.....*C. beniteguri* JORDAN et SNYDER
Syn. *C. ornatipinnis* REGAN;
C. kanekonis TANAKA

13b. Caudal rounded, last dorsal and anal rays not extending beyond base of caudal; 1st dorsal with a few blackish spots; anal pale, but the outer edge black .....*C. valenciennesi* TEMMINCK et SCHLEGEL

12c. Dorsal spines highly produced, the membrane high and joined to 1st dorsal soft ray at base; eye shorter than snout .....*C. virgis* JORDAN et FOWLER

8b. Urinogenital papilla very short and rudimentary (female).
14a. Last dorsal and anal soft rays not reaching base of caudal when the fins are depressed.
15a. Dorsal spines more or less filamentous, the 1st spine the longest, reaching base of 2nd dorsal soft ray when the fin laid back; anal generally pale .....*C. flagris* Jordan et Fowler
15b. Dorsal spines not filamentous except for the 1st one, which scarcely or not reaching base of 1st dorsal soft ray.
16a. 1st dorsal uniformly black.
17a. Eye moderately large, about as long as snout; sides of anal black medially...*C. lunatus* Temminck et Schlegel
17b. Eye longer than snout; sides of anal not black medially.....*C. virgis* Jordan et Fowler
16b. A dark blotch, crescentic in shape, present on spinous dorsal between 2nd and 3rd spines, and a similar but larger one between 3rd and 4th spines .....*C. kitaharai* Jordan et Seale
14b. Last dorsal and anal soft rays extending base of caudal when the fins laid back; anal pale.
18a. 1st dorsal with numerous dusky lines and whitish specks on membranes of anteriormost 2 spines, but the rest of the fin blackish .....*C. beniteguri* Jordan et Snyder
18b. 1st dorsal pale, with a large blackish ocellus between 3rd and 4th spines .....*C. punctatus* Langsdorff

Callionymus japonicus Houttuyn

Yome-gochi

(Fig. 1)

Callionymus japonicus.—Houttuyn, 1782 : 311.
Callionymus longicaudatus.—Temminck et Schlegel, 1845 : 151, pl. 79, fig. 1 ; Günther, 1861 : 148-149 ; Nyström, 1887 : 36 ; Day, 1889 : 303-304 ; Blegvad, 1944 : 174 ; Boeseman, 1947 : 130.
Callionymus reevesii.—Richardson, 1846 : 210 ; Evermann et Seale, 1907 : 103 ; Roxas et Martin, 1937 : 241.
Calliurichthys japonicus.—Jordan et Fowler, 1903 : 942-943, fig. 2 ; Smith et Pope, 1906 : 493 ; Franz, 1910 : 84 ; Snyder, 1912 : 446 ; Jordan, Tanaka et Snyder, 1913 : 373, fig. 330 ; Jordan et Thompson 1914 : 294, fig. 71 ; Izuka et Matsuura, 1920 : 190 ; Jordan et Hubbs, 1925 : 316 ; Mori, 1928 : 8 ; Ui, 1929 : 262 ; Kuroda, 1931 : 124 ; Schimidt, 1931b : 141 ; Wu, 1931 : 56 ; Mori et Uchida, 1934 : 21 ; Nakamura, 1934 : 25 ; Kamohara, 1936 : 7 ; Koike, 1936 : 13 ; Mako, 1949 ; 134 ; Katayama, 1950 : 10 ; Yanai, 1950 : 22 ; Chen, 1951 : 161 ; Kuroda, 1951 : 385 ; Kamohara, 1952 : 89 : Mori, 1952 : 133.
Callionymus numeri.—Tanaka, 1917 : 12.
Callionymus, Calliurichthys japonicus.—McCulloch, 1926 : 196-197.

Material examined.—Male. Nos. (Matsubara's Fish Coll.) 1178 and 1235, 145-211 mm in standard length (255-354.5 mm in total length), locality unknown. No. 8862, 140 mm (299 mm), Kanaiwa, Ishikawa Pref., October 26, 1942. No. 11106, 147 mm (251 mm), Kanaiwa,

April 3, 1949. No. 11457, 204.5 mm (359 mm), Japan Sea, October 3, 1948. Nos. 15039, 15043 and 15047, 36–104 mm (50–173 mm), Saheki Bay, Ôita Pref., January 3, 1951. No. 21272, 117 mm (194 mm), Owase, Mie Pref., November 5, 1953. Nos. 21349, 21350 and 21352, 215–228 mm (376–425 mm), locality unknown. Nos. 22006, 22011, 22014, 22017, 22019, 22023, 22025, 22032–22033, 22035 and 22037–22040, 70–207 mm (103.5–355.5 mm), Mimase, Kôchi City, April 10–20, 1954. Nos. 23252–23256, 99–277 mm (159–420 mm), off Shibushi, Kagoshima Pref., September 1–3, 1954. Nos. 23614–23617, 189–205 mm (360–396 mm), Yahatahama, Ehime Pref., October 10, 1954.

Female. No. 1489, 167.5 mm (262 mm), Owase, December 6–9, 1935. No. 11456, 155 mm (264 mm), Japan Sea, October 3, 1948. No. 13046, 142.5 mm (223 mm), Wakasa Bay, May 1950. Nos. 15038, 15040, 15044–15045 and 15048–15050, 48–79 mm (71–123 mm), Saheki Bay, January 3, 1951. Nos. 15293–15294, 72–87 mm (106–130 mm), Owase, January 15–20, 1950. Nos. 18557–18559, 123–155 mm (204–257 mm), Mimase, October 10, 1952. Nos. 22007–22010, 22015–22016, 22018, 22020–22022, 22024, 22026–22031, 22036, 22038 and 22041–22043, 61–166 mm (86–258 mm), Mimase, April 10–24, 1954. No. 23068, 156 mm (246 mm), Yahatahama, August 30, 1954. Nos. 24776–24777, 50.5–72 mm (73–112 mm), Owase, October 25, 1954.

Description.—D. 1V, 9 to 10 (9.0)*; A. 8 to 9 (8.0); P. 18 to 21 (19.5). Body width 5.7 to 9.2 (7.1) in standard length; body depth 8.8 to 15.5 (11.0); depth of caudal peduncle 16.7 to 25.5 (19.8). Eye diameter 2.5 to 4.5 (3.0) in head length; 3rd dorsal spine 1.2 to 2.2 (1.4); 4th dorsal spine 1.4 to 3.0 (2.0); 1st dorsal soft ray 1.1 to 1.8 (1.3) 6th dorsal soft ray 1.1 to 1.7 (1.3); last dorsal soft ray 0.9 to 1.8 (1.2); pectoral fin 1.0 to 1.4 (1.2); pelvic fin 0.7 to 1.1 (0.9).

Preopercular spine strong, sharp and straight, as long as eye, the upper edge finely serrated, and the basal spinule directed forward. Upper surface of occipital region with a pair of elevated crests, striated, and separated from each other by the smooth integument of head. Last dorsal and anal soft rays reaching base of caudal fin except for the mature male.

First dorsal dark grey with some oblique dark bands, and a large jet black ocellus between third and fourth spines. Second dorsal greyish with narrow bands of longitudinal black blotches. Caudal crossed by several or more blackish bars, and the lower margin broadly edged with black. Anal broadly edged with black, but the tips of rays pale.

Sexual dimorphism.—In this species, there exist marked sexual difference in the coloration and shape of the fins. This divergence appears to be related to the age of the fish, and becomes conspicuous in 90 mm in standard length. In the male, the anteriormost two dorsal spines are slender and produced into long filaments, and about twice as long as the head. The four median caudal rays are also very long, the longest of which is often approximately as long as the body exclusive of the caudal. The snout is long and pointed, usually longer than the eye diameter. The lower surface of the body is pale, but a deep brown blotch is placed on the chest.

On the other hand, in the female, the dorsal spines are all short and never produced into filaments, and gradually becoming shorter posteriorly. The four median caudal rays are also elongated, but the longest one is shorter than the body. The

* The averages of counts and measurements are put in parentheses.

Table 1. Sexual dimorphism found in some proportional measurements in adults of *Callionymus japonicus* Houttuyn.

Items \ Sex	Male		Female	
	Range	Average	Range	Average
In standard length: Head	4.0–5.1	4.4	4.0–4.9	4.6
In head length: Snout	2.1–3.4	2.7	2.5–3.0	2.9
1st dorsal spine	0.6–1.2	0.9	1.1–1.2	1.2
2nd dorsal spine	0.6–1.3	0.9	1.2–1.5	1.4
Caudal fin	0.2–0.4	0.3	0.3–0.4	0.4

snout is blunt about as long as the eye diameter. The lower surface of the body is uniformly pale.

Youngs.—In young specimens, the head is rather large, about a fourth of the

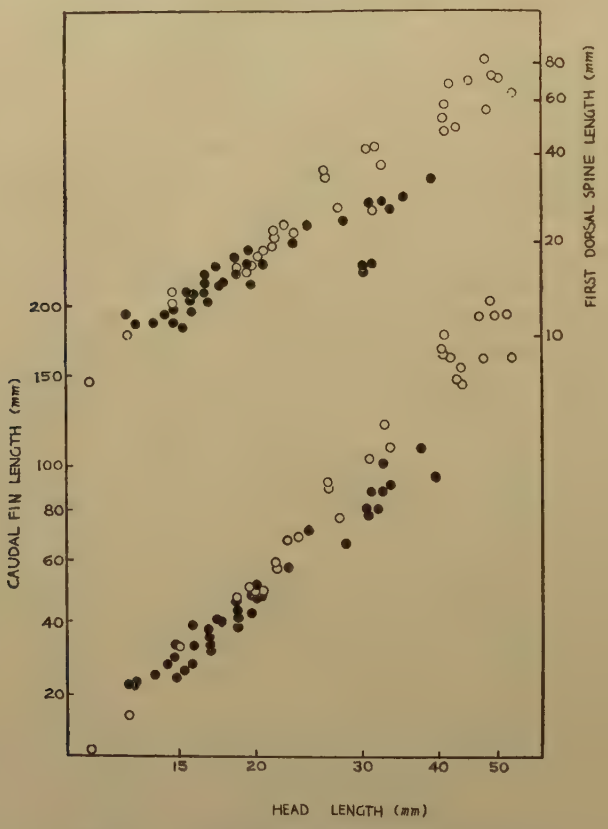

Fig. 1. Dimension of first dorsal spine and caudal fin in *Callionymus japonicus* Houttuyn in relation to the head length. ○, male. ●, female.

standard length. The snout is rather pointed, but shorter than the eye diameter in a very small specimens. The anteriormost two dorsal spines are neither produced nor filamentous even in the male. The caudal fin is rounded, and the longest ray is twice as long as the head. The striated bony crests on the top of the head are more or less inconspicuous, and in the smallest one at our disposal (No. 15043, 36 mm in standard length) the head is entirely smooth. The under side of the body is uniformly grey.

Table 2. Proportional measurements of several body parts in youngs of *Callionymus japonicus* HOUTTUYN.

Sex / Items	Male		Female	
	Range	Average	Range	Average
In standard length:				
Head	3.3–4.5	4.1	3.7–4.5	4.1
In head length:				
Snout	2.6–4.2	3.5	2.4–4.3	3.3
1st dorsal spine	1.1–1.6	1.3	1.0–1.5	1.2
2nd dorsal spine	1.2–1.4	1.3	1.2–1.5	1.4
Caupal fin	0.4–0.8	0.5	0.4–0.6	0.5

REMARKS.—TANAKA's *Calliurichthys numeri* (1917 : 7–12) caught at Misaki appears to be nothing more than the female of this species inasmuch as the species in his description agrees perfectly with the present specimens of females in the important features. The present species accords well with *Calliurichthys decoratus* GILBERT (1905 : 651, pl. 90) known from Hawaiian Islands in the general form of the body and coloration on the sides of the body, but presumably be distinguished from it in the general form and color pattern of the first dorsal fin.

Callionymus variegatus TEMMINCK et SCHLEGEL

Itohiki-numeri

Callionymus variegatus.—TEMMINCK et SCHLEGEL, 1845 : 153.
Calliurichthys variegatus.—JORDAN et FOWLER, 1903 : 944-945, fig. 3 ; FRANZ, 1910 : 84 ; JORDAN, TANAKA et SNYDER, 1913 : 373, fig. 331 ; IZUKA et MATSUURA, 1920 : 109 ; UI, 1929 : 262 ; CHEN, 1951 : 161.

Unfortunately no specimens have come under our examination. On going through literature given by TEMMINCK and SCHLEGEL (1845) and JORDAN and FOWLER (1903), this species is closely related to *Callionymus japonicus* in several important features, but sharply defined from it in several items, thus : dorsal soft rays are always 8 (9 in the latter) ; and soft rays are 7 (8 in the latter) ; preopercular spine is short, always shorter than the diameter of eye (longer than it in the latter) ; a single broad rugosely striated patch on top of head (2 in the latter) ; soft dorsal is pale and fur-

nished with alternate wavy lines of grey and black (soft dorsal with narrow bands of longitudinal brown blotches in the latter).

In the male, the anteriormost two dorsal spines are produced into long filaments, but the others are not filamentous. The caudal fin is very long, heavy, while the median ray is the longest, about 0.7 times as long as the body exclusive of the caudal fin. The lower surface of the head is whitish, with a deep brown blotch.

In the female, the dorsal spines are neither elongated nor filamentous, and the caudal fin is short, and the under side of the head white.

Callionymus doryssus (Jordan et Fowler)

Yari-numeri

(Fig. 2)

Calliurichthys doryssus.—Jordan et Fowler, 1903 : 945–947, fig. 4 ; Smith et Pope, 1906 : 493 ; Snyder, 1912 : 446 ; Jordan, Tanaka et Snyder, 1913 : 372, fig. 329 ; Jordan et Thompson, 1914 : 294, fig. 72 ; Jordan et Hubbs, 1925 : 316 ; Ui, 1929 : 262 ; Schmidt, 1913 b : 141 ; Katayama, 1940 : 24 ; Yanai, 1950 : 22 ; Kuroda, 1951 : 385 ; Kuroda, 1952 : 174 ; Mori, 1952 : 133 ; Kuroda, 1954 : 160.

Material examined.—Male. No. 4691, 120 mm in standard length (161.5 mm in total length), Owase, Mie Pref., December 1936. Nos. 18530–18532, 18534–18536, 18538–18543, 18545–18546, 18549–18554 and 18556, 96–122.5 mm (154–178 mm), Mimase, Kôchi City, October 10, 1952. No. 20681, 86 mm (115 mm), Miya, Aichi Pref., April 10, 1953. Nos. 21938–21940, 21945–21953, 21955–21956, 21958–21961, 21963–21966, 21969, 21972–21976, 21978, 21981–21982, 21986, 21989–21996, 22000, 22003 and 22005, 53–100 mm (70–142 mm), Mimase, April 10–20, 1954. No. 23065, 118 mm (167.5 mm), Yahatahama, Ehime Pref., August 30, 1954. Nos. 23297–23301, 81–125 mm (138–184 mm), off Shibushi, Kagoshima Pref., September 3, 1954.

Female. No. 11292, 61 mm (86 mm), Tsuiyama, Hyôgo Pref., April 4, 1949. No. 13948, 94 mm (125 mm), Owase, September 20, 1950. No. 15042, 47 mm (62 mm), Saheki Bay, Ôita Pref., January 3, 1951. No. 15292, 90 mm (121 mm), Owase, January 15–20, 1950. Nos. 17169 and 17180, 79–94.5 mm (104–125 mm), Miya, January 8–11, 1951. Nos. 18533, 18537, 18544, 18547–18548 and 18555, 85–105 mm (115–137 mm), Mimase, October 10, 1952. Nos. 20679–20680, 50–94 mm (67–125 mm), Miya, April 10, 1953. Nos. 21383, 21385, 21387 and 21388, 65–70 mm (84–88 mm), Miya, January 25, 1954. Nos. 21937, 21941–21944, 21954, 21957, 21962, 21967–21968, 21970, 21977, 21980, 21983, 21985, 21987–21988, 21998, 22001–22002 and 22004, 48–92 mm (64–120 mm), Mimase, April 10–20, 1954. Nos. 23061–23062, 46–109 mm (59–142 mm), Maizuru, August 26, 1954. Nos. 23064, 23066 and 23067, 98.5–109 mm (128.5–142 mm), Yahatahama, August 30, 1954.

Description.—D. IV, 9 ; A. 9 to 10 (9.0) ; P. 18 to 20 (19.2). Head 3.3 to 4.3 (3.8) in standard length ; body width 5.6 to 7.7 (6.2) ; body depth 7.1–12.2 (9.4) ; depth of caudal peduncle 16.5 to 24.0 (19.3). Snout length 2.3 to 3.4 (3.1) in head length ; eye diameter 2.6 to 3.9 (3.1) ; 4th dorsal spine 2.1 to 5.2 (3.8) : 1st dorsal soft ray 1.4 to 2.0 (1.6), 2nd dorsal soft ray 1.5 to 2.1 (1.7) ; 6th dorsal soft ray 1.3 to 2.5 (1.8) ; 1st anal ray 2.1 to 3.4 (2.6) ; pectoral fin 1.1 to 1.6 (1.3) ; pelvic fin 0.8 to 1.3 (1.1).

Preopercular spine about as long as eye diameter, the upper edge finely serrated, and the base armed with a spinule directed forward. Upper surface of head entirely

smooth. Last dorsal soft ray much longer than last anal ray, extending beyond base of caudal in the former, instead of being scarcely reaching it in the latter; the fins, however, never reaching it in the youngs.

SEXUAL DIMORPHISM.--Remarkable sexual dimorphism exists in the form of the fins. This divergence appears to be related to the age of the fish inasmuch as it becomes conspicuous when the fish attains 65 mm in standard length. In the male, the dorsal spines are long, slender and produced into long filaments, and the anteriormost two spines are especially elongated and much longer than the head. The caudal fin is also elongated, but scarcely twice as long as the head.

Table 3. Sexual dimorphism found in some proportional measurements against head length in adults of *Callionymus doryssus* (JORDAN et FOWLER).

Sex / Items	Male		Female	
	Range	Average	Range	Average
1st dorsal spine	0.4–1.0	0.6	0.6–2.0	1.3
2nd dorsal spine	0.5–1.4	0.7	1.0–2.5	1.6
3rd dorsal spine	0.8–2.1	1.3	1.9–2.8	2.2
Last dorsal ray	0.9–1.5	1.3	1.2–1.7	1.4
Caudal fin	0.5–1.0	0.6	0.7–0.9	0.8

In the female, on the other hand, although the dorsal spines are elongated and filamentous, they are much shorter than the head. The caudal fin is moderately long, somewhat longer than the head.

YOUNGS.—In the youngs, the eye is rather large, and longer than the snout; the last dorsal and anal soft rays are not reaching the base of caudal fin. In the female the dorsal spines are not produced into filaments, but in the male they are more or less elongated.

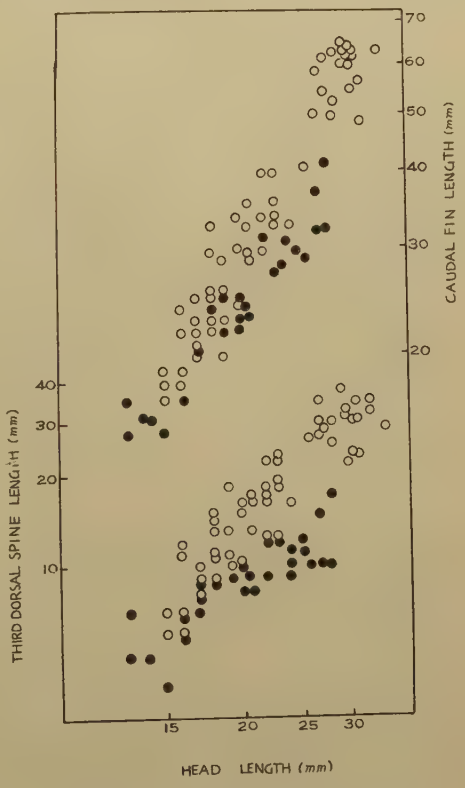

Fig. 2. Dimensions of third dorsal spine and caudal fin in *Callionymus doryssus* (JORDAN et FOWLER) in relation to head length. ○, male. ●, female.

Table 4. Proportional measurements of dorsal spines, last dorsal ray and caudal fin against head length in youngs of *Callionymus doryssus* (Jordan et Fowler).

Sex / Items	Male		Female	
	Range	Average	Range	Average
1st dorsal spine	0.7–1.4	1.0	0.8–3.0	1.7
2nd dorsal spine	0.9–1.8	1.3	1.3–3.0	2.2
3rd dorsal spine	1.2–2.7	1.9	1.7–3.8	2.6
Last dorsal ray	1.3–1.7	1.6	1.6–1.9	1.8
Caudal fin	0.5–0.9	0.8	0.7–1.3	0.9

Callionymus calliste Jordan et Fowler

Hanabi-numeri

Callionymus calliste.—Jordan et Fowler, 1903 : 954–955, fig. 8; Jordan, Tanaka et Fowler, 1913 : 377, fig. 337; Kuroda, 1931 : 124; Schmidt, 1931 b : 143–144, fig. 26; Böhlke, 1953 : 103.

No specimens have come under our examination, but according to the original description and some other comments, this species is characterized in the following points: dorsal soft rays 8; anal soft rays 7; preopercular spine armed with 3 hooks on the upper margin, and at the base a spinule directed forward; lateral line not connected by a branch with a fellow of opposite side on top of caudal peduncle.

In the male, dorsal spine are long, slender; the first two spines are about equal and a little longer than the base of soft dorsal; the third is longer than either of them; the last is the shortest, although the distal part produced into filamentous. The last dorsal soft ray is reaching the base of caudal when the fin is laid back, but the last anal soft ray extends further behind. The first dorsal fin is grey, dotted with several blackish ocelli at the base, and marked with darker grey lines and spots; the anal fin is greyish white except for the blackish margin and mottled with greyish posteriorly.

In the female, the first two spines of the dorsal are subequal in length, and about equal to 1.6 times in the length of head. The last rays of both dorsal and anal fin are not reaching the base of caudal fin when the fin is depressed. The first dorsal is uniformly blackish; the anal fin is yellow, without any dark markings.

Callionymus phasis Günther

Daruma-numeri (new Japanese name)

(Fig. 3)

Callionymus phasis.—Günther, 1879 : 28, pl. 40, fig. c; McCulloch, 1926 : 212; McCulloch, 1929 : 338; McCulloch, 1934 : 77; Norman, 1937 : 56.

MATERIAL EXAMINED.—Female. No. 24847, 44 mm in standard length (58 mm in total length), Yahatahama, Ehime Pref., September 10, 1954.

The present species has never heretofore been recorded from the Japanese waters.

DESCRIPTION. –D. IV, 8; A. 7; P. 18; C. 10. Head 3.5 in standard length; body width 4.9; body depth 6.3; depth of caudal peduncle 13.7. Snout length 4.0 in head length; eye diameter 3.0; interorbital width 12.0; 1st and 2nd dorsal spines each 1.8; 3rd dorsal spine 2.0; 4th dorsal spine 3.4; 1st and 2nd dorsal soft rays each 1.4; 6th and last dorsal soft rays each 1.7; 1st anal ray 2.6; pectoral fin 1.1; pelvic and caudal fins each 0.8.

Body somewhat elongate and depressed. Trunk broad and tail scarcely tapering backward. Head rather blunt and triangular in upper view. Snout narrow and pointed. Eye very large, close together on top of head. Preopercular spine considerably short, about half as long as eye diameter, terminating in three curved hooks, of which two anterior ones large and directed upwards; a short spinule projecting forward from base of the spine. Gill-opening reduced to a small foramen on the upper side of

Fig. 3. Lateral view of *Callionymus phasis* GÜNTHER (female): No. 24847, 44mm in standard length. Drawn by OCHIAI.

neck. Lateral line single on each side, each connected on the occiput, but not connected on the upper surface of caudal base.

Dorsal spines rather short and completely connected by membrane, the anteriormost three spines subequal in length and longer than last spine. Soft dorsal rays moderately long, gradually becoming shorter posteriorly. Anal begins under second dorsal soft ray, the rays become higher posteriorly, but the last one not produced and never reaching base of caudal when the fin is depressed. Caudal roundish, the median ray the longest and graduated above and below. Pectoral broad, the rays branched except for the uppermost two. Ventral long, extending beyond origin of anal.

Body olive brown, with several irregular indefinite broad blackish cross bands on back and sides, the lower surface yellow. First dorsal black, narrowly edged anteriorly

with pale. Pectoral, caudal and second dorsal rays furnished with many black spots in lengthwise series. Anal pale. Ventral scattered with some black spots.

Remarks.—According to the original description of the present species given by Günther, the male is characterized by the following points: dorsal spines are all prolonged, the first three spines are about as long as the head; the first dorsal fin is blackish with some whitish zig-zag lines; the caudal fin is rather long, the longest ray is longer than the head. Günther indicated in his illustration of this species (pl. 15, fig. c) that the dorsal soft rays are all branched at their tips, but in our single specimen examined the rays are all simple except for the last one.

The present species is closely related to *Callionymus lineolatus* Cuvier et Valenciennes given by Day (1889: 305, fig. 101), but separable from it in having larger eyes and no remarkable color pattern in the anal fin.

Callionymus planus Ochiai sp. nov.

Hera-numeri

(Figs. 4–5)

Holotype.—Male. No. 20685, 98 mm in standard length (125 mm in total length), Miya, Aichi Pref., April 10, 1953.

Paratypes.—Male. Nos. 17163–17166, 89–105 mm (113–135 mm), Miya, January 8–11, 1951. No. 23640, 78.5 mm (100 mm), Owase, Mie Pref., October 20, 1954.

Female. Nos. 16960–16961, 96–97 mm (120–122 mm), Miya, September 1951. No. 17167, 87.5 mm (118 mm), Miya, January 8–11, 1951. Nos. 21877–21895, 41–88 mm (51–113 mm), Mimase, Kôchi City, April 15, 1954. Nos. 23638, 23641 and 23642, 73–79 mm (91–100 mm), Owase, October 20, 1954.

Description.—Holotype. D. IV, 9; A. 9; P. 21; C. 10. Head 4.1 in standard length; body width 6.1; body depth 10.9; depth of caudal peduncle 19.6. Snout length 3.0 in head length; eye diameter 3.4; interorbital width 13.3; 1st dorsal spine 2.0; 2nd dorsal spine 3.0; 3rd dorsal spine 3.4; 4th dorsal spine 4.0; 1st dorsal soft ray 1.7; 2nd dorsal soft ray 1.8; 6th dorsal soft ray 1.7; last dorsal soft ray 1.3; 1st anal ray 2.4; pectoral fin 1.0; pelvic and caudal fins each 0.9.

Body elongate and strongly depressed. Trunk broad and flattish. Head very broad and depressed, more than twice as long as deep, and shorter than wide. Snout short and rather pointed. Eye rounded, slightly shorter than snout. Interorbital space flat and somewhat concave, nearly as broad as a quater the diameter of eye. Mouth small and inferior, upper jaw projecting beyond the lower when mouth is closed, and posterior end of maxillary reaching front edge of nostril. Teeth villiform, in broad bands on jaws. Preopercular spine about as long as eye diameter, the upper edge slightly rounded, armed with several rather robust hooks, and the base armed with a sharp spinule directed forward. Gill-opening rounded, nearer origin of dorsal than posterior margin of eye. Lateral line single, with some short branches directed

obliquely backward and downward; the line connected by a branch with a fellow of opposite side on occiput and on upper surface of caudal base.

First dorsal begins midway between gill-opening and origin of pectoral fin. Dorsal spines not elongated, the first the longest, but not extends to origin of second dorsal when the fin is depressed. Both second and third spines about as long as eye diameter. Fourth spine the shortest. Dorsal soft rays also short and simple except for the last branched and produced one, the tip extends beyond base of caudal fin. Anal fin begins slightly behind a perpendicular through origin of first dorsal ray, and the last one extends beyond base of caudal. Pectoral fin rays branched except for simple two uppermost rays, the median rays the longest, about as long as head. Ventral very long, extending beyond origin of anal. Caudal rounded and slightly longer than head.

Body blackish brown, whitish below; the upper surface rather densely covered with pale spots, surrounded by both numerous small spots and fine reticulation of

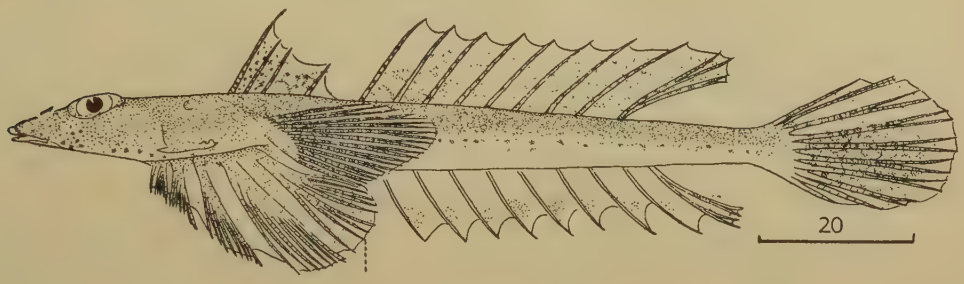

Fig. 4. Lateral view of *Callionymus planus*. Holotype (male): No. 20685, 98mm in standard length. Drawn by OCHIAI and ARAGA.

darker; the lateral side furnished with many dark specks. Dorsal pale, with fine dark vermiculations. Pectoral pale, but the upper half rays furnished with dark brown spots. Ventral pale, vermiculated with blackish specks. Anal pale, a series of blackish blotches running along the outer margin. Caudal dusky, mottled with minute dark spots, forming dark rings enclosing lighter spots.

Paratype.—D. IV, 9; A. 9; P. 20 to 21. Head 4.1 to 4.5 in standard length; body width 6.0 to 6.5; body depth 8.7 to 11.2; depth of caudal peduncle 18.0 to 22.4. Snout length 2.6 to 3.3 in head length; eye diameter 2.9 to 3.5; interorbital width 9.3 to 15.3; 1st dorsal spine 1.8 to 1.9; 2nd dorsal spine 2.7 to 3.1; 3rd dorsal spine 2.9 to 4.2; 4th dorsal spine 3.3 to 4.2; 1st dorsal soft ray 1.5 to 1.8; 2nd dorsal soft ray 1.5 to 1.9; 6th dorsal soft ray 1.5 to 1.7; last dorsal soft ray 0.9 to 1.0; 1st anal soft ray 2.4 to 2.9; pectoral fin 0.9 to 1.0; pelvic fin 0.6 to 0.8; caudal fin 0.8 to 0.9. Color and other characters agree well with those of the holotype.

Female.—D. 111 to IV, 8 to 10 (9); A. 9 to 10 (9.1); P. 19 to 21 (19.8). Head 3.4 to 4.1 (3.8) in standard length; body width 5.5 to 10.8 (6.4); body depth 8.2 to 13.8 (9.8); depth of caudal peduncle 18.0 to 27.0 (21.4). Snout length 2.9 to 4.3 (3.6) in head length; eye diameter 2.8 to 3.8 (3.2); interorbital width 11.0 to 20.0 (14.7); 1st dorsal spine 2.0 to 3.0 (2.4); 2nd dorsal spine 2.0 to 3.1 (2.5); 3rd dorsal spine 2.6 to 3.8 (3.0); 4th dorsal spine 3.4 to 6.5 (4.8); 1st dorsal soft ray 1.7 to 2.8 (1.9); 6th dorsal soft ray 1.8 to 2.3 (2.1); last dorsal soft ray 1.5 to 1.9 (1.7); 1st anal ray 2.3 to 3.3 (2.8); pectoral fin 1.0 to 1.4 (1.1); pelvic fin 0.7 to 1.4 (1.0); caudal fin 0.9 to 1.1 (1.0).

Dorsal, anal and caudal fins more or less shorter than those of the males. Colorations of body and fins agree well with those of male except for first dorsal and anal

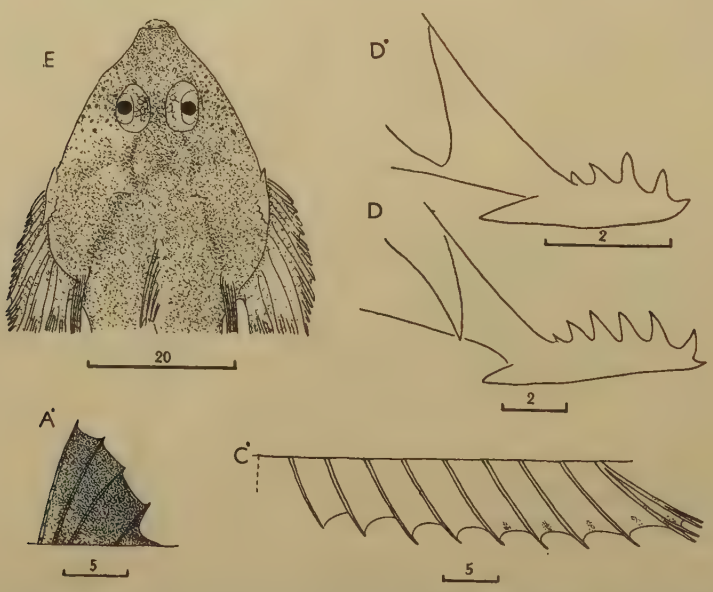

Fig. 5. First dorsal (A'), anal (C'), preopercular spine (D, D') and dorsal view of the head (E) in *Callionymus planus*, sp. nov. A', C' (No. 21893) and D' (No. 21914), female; D (No. 21884) and E (No. 20685), male. Drawn by Ochiai and Araga.

fin. First dorsal uniformly black (Fig. 5A'); anal fin pale, with small obscure blackish spots (Fig. 5C').

Remarks.—The present new species is easily distinguished from other Japanese species of this group in having wider preopercular spine armed with several robust hooks, and a wider head. The Australian species, *Callionymus macdonaldi* Ogilby given by McCulloch (1926: 205–207, pl. 54, fig. 1) tallies well with the present species, but the top of the head armed with a pair of finely reticulated tubercles (in the latter, the head is largely smooth), and the head is approximately as wide as long (in the latter, the head is much shorter than wide).

Callionymus sokonumeri KAMOHARA

Soko-numeri

(Figs. 6–7)

Callionymus sokonumeri.—KAMOHARA, 1936 : 448, fig. 2; KAMOHARA, 1938 : 65–66, fig. 36; KAMOHARA, 1952 : 90, fig. 87.

MATERIAL EXAMINED.—Male. No. 18595, 112 mm in standard length (162 mm in total length), Mimase, Kôchi City, October 10, 1952. No. 24779, 89 mm (132 mm), Owase, Mie Pref., October 20, 1954. Nos. 25174–25175, 101–107 mm (161 mm–174 mm), Mimase, March 20, 1955.
Female. No. 18178, 125 mm (162 mm), Mimase, October 10, 1952.

DESCRIPTION.—D. IV, 9; A. 9; P. 18 to 20; C. 10. Head 3.6 to 4.4 in standard length; body width 5.2 to 7.1; body depth 8.3 to 9.9; depth of caudal peduncle 20.1 to 22.4. Snout length 3.2 to 4.1 in head length; eye diameter 2.1 to 2.9; 1st anal ray 1.9 to 2.5; pectoral fin 1.1 to 1.6; pelvic fin 0.9 to 1.1.

Body elongate, moderately depressed and tapering backward. Trunk broad. Head depressed and moderately broad, about as wide as long. Snout rather pointed and much shorter than eye diameter. Eyes large, approaching with each other. Preopercular spine much shorter than eye, with three hooks above, the hindmost of which directed backward and upward, and barbed (Fig. 6). Caudal fin long, the two median rays produced into long filaments, the second as well as the ninth one from the upper also produced, forming a pair of concavity between them and the axial filaments on posterior margin of the fin. Dorsal soft rays elevated, and the middle ones higher than the others, and the last one scarcely reaching base of caudal when the fin is depressed.

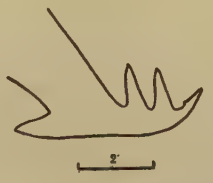

Fig. 6. Preopercular spine in *Callionymus sokonumeri* KAMOHARA (male) : No. 18595, 112 mm in standard length. Drawn by ARAGA.

Body olive yellow, whitish below; the back with both blackish spots and blotches, the former forming dark rings; the side with a series of several dark brown specks. First dorsal grey, with three oblique dark bands; an irregular blackish blotch placed between third and fourth spines. Second dorsal also grey, with several vertical dark streaks on membranes. Caudal grey, mottled with blackish specks and small whitish blotches. Pectoral pale, the upper part mottled with dark specks. Ventral grey, the inner distal edge conspicuously dark.

SEXUAL DIMORPHISM.—Remarkable sexual dimorphism is found to exist in this species in the coloration and shape of the fin (Table 5). In the male, the dorsal spines moderately elongate, the first spine is the longest, and the tip reaches to or extends beyond the base of the second dorsal soft ray when the fin is depressed. The second dorsal fin is strongly elongated, the longest ray is about as long as or

much longer than the head. The caudal fin greatly elongated, the two median rays are filamentous, about twice as long as the head. The last soft anal ray scarcely reaches the base of the caudal fin. The anal fin is pale, the distal half is marked with blackish oblique lines running on the membranes between the rays. In our smallest specimen (No. 23779, 89 mm in standard length), however, the fin is pale and broadly edged with black uniformly.

Table 5. Sexual dimorphism in some proportional measurements against head length in *Callionymus sokonumeri* Kamohara.

Items \ Sex	Male	Female
1st dorsal spine	0.9–1.3	1.6
2nd dorsal spine	1.2–1.4	1.7
3rd dorsal spine	1.2–1.4	1.8
4th dorsal spine	1.9–2.7	3.2
1st dorsal soft ray	0.9–1.2	1.4
2nd dorsal soft ray	0.8–1.1	1.4
6th dorsal soft ray	0.7–1.0	1.3
last dorsal soft ray	0.9–1.3	1.5
Caudal fin	0.4–0.6	0.8

In the female, the dorsal spines are rather short, the first spine is longer than others, and nearly reaching to the base of the first dorsal soft ray when the fin is laid back. The second dorsal is moderately high, the highest one being a little shorter than the head. The two median caudal rays are the longest, but not filamentous, and slightly longer than the head. The anal fin is also rather high, but the last ray not extending to the base of the caudal fin when the fin is depressed. The fin is pale and more or less edged with dark.

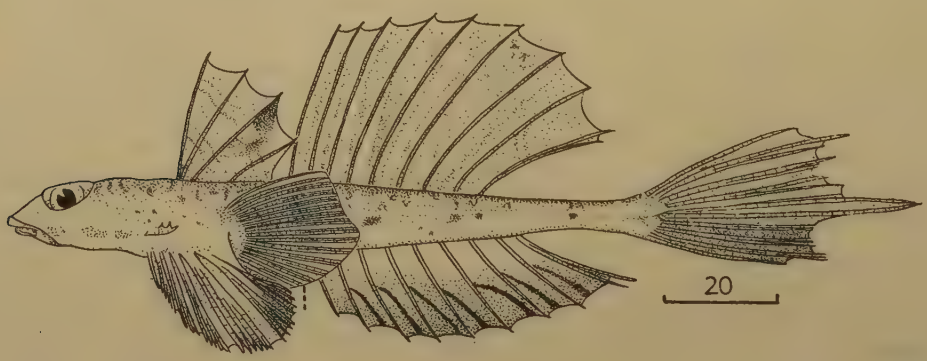

Fig. 7. Lateral view of *Callionymus sokonumeri* Kamohara (male): No. 18595, 112 mm in standard length. Drawn by Ochiai.

REMARKS.—Our male specimens so far examined agree well with the holotype of this species in description (KAMOHARA, 1936, fig. 2) except for the general form of the caudal fin. In the latter, none of the caudal rays, except for the two median filamentous ones, are produced beyond the general contour of the fin.

Callionymus kaianus GÜNTHER

Tongari-numeri (new Japanese name)

(Figs. 8–10)

Callionymus kaianus.—GÜNTHER, 1879 : 44, pl. 19, fig. b; ALCOCK, 1899 : 74; REGAN, 1908 : 248; BEAUFORT et CHAPMAN, 1951 : 66–67, fig. 12.

MATERIAL EXAMINED.—Male. Nos. 23259, 23261–23263, 23265–23367, 23269–23270, 23273–23276, 23281–23286, 23288–23291 and 23296, 72.5–125 mm (98–171.5 mm), Shibushi, Kagoshima Pref., September 1–3, 1954. Nos. 23778 and 24783, 76–82 mm (102–111.5 mm), Owase, Mie Pref., October 25, 1954.

Female. Nos. 19687–19688, 95–100 mm (129–133 mm), Nobeoka, Miyazaki Pref., December 10, 1952. Nos. 21864, 21866–21868, 21870 and 21873–21876, 38–96 mm (50–126 mm), Mimase, Kôchi City, April 10–20, 1954. Nos. 23257–23258, 23260, 23262, 23264, 23268, 23271, 23277, 23280 and 23292–23295, 72–123 mm (98–158.5 mm), Shibushi, September 1–3, 1954. No. 23780, 72.5 mm (95.5 mm), Owase, September 25, 1954.

The present species has never heretofore been reported from our waters.

DESCRIPTION.—D. IV, 9; A. 9; P. 18 to 21 (19.5); C. 10. Head 3.5 to 4.4 (4.1) in standard length; body width 5.9 to 8.6 (6.8); body depth 7.8 to 13.1 (10.2); depth of caudal peduncle 19.3 to 31.0 (25.6). Snout length 2.8 to 4.0 (3.3) in head length; eye diameter 2.3 to 3.0 (2.6); interorbital width 14.5 to 29.0 (21.9); 1st dorsal soft ray 1.2 to 1.9 (1.5); 2nd dorsal soft ray 1.2 to 1.8 (1.5); 6th dorsal soft ray 1.2 to 2.2 (1.5); 1st anal ray 2.2 to 3.6 (2.7); pectoral fin 1.0 to 1.6 (1.3); pelvic fin 0.9 to 1.5 (1.1).

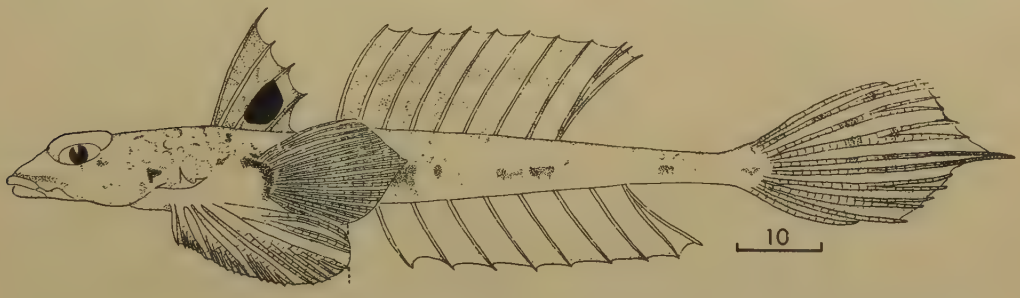

Fig. 8. Lateral view of *Callionymus kaianus* GÜNTHER (male): No. 23274, 91 mm in standard length. Drawn by OCHIAI.

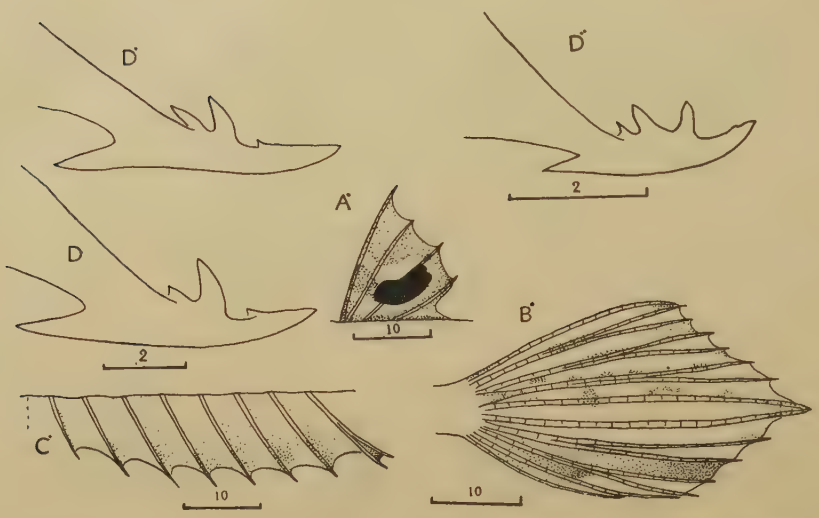

Fig. 9. First dorsal (A′), caudal (B′), anal fin (C′) and preopercular spines (D, D′, D″) in *Callionymus kaianus* Günther. D (No. 23283), male; A′, B′, C′ (No. 23294), D′ (No. 23257) and D″(No. 21867), female. Drawn by Ochiai and Araga.

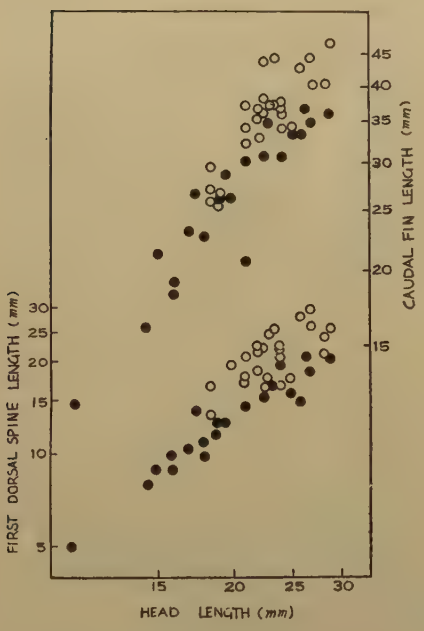

Fig. 10. Dimentions of first dorsal spine and caudal fin length in *Callionymus kaianus* Günther in relation to head length. ○, male. ●, female.

Body elongate, moderately depressed and tapering backward. Trunk broad. Head depressed, about as broad as long. Snout short and narrow, conspicuously shorter than eye diameter. Eyes large, narrowly separated from each other. Preopercular spine shorter than eye, armed with three or four hooks above, the hindmost one of which barbed; a spinule directed forward from base of preopercular spine (Fig. 9D, D′). Gill-opening reduced to a small foramen on each side of neck. Lateral line single, connected by a branch with a fellow of opposite side on occipital region and also on upper surface of caudal base. Dorsal and anal soft rays moderately high, the last one never reaching base of caudal when the fins are depressed.

Body brownish yellow above, whitish below; the back with minute blackish spots, forming rings and blotches; the sides crossed by several dark brown blotches and with many irregular faint specks. First dorsal

grey, with a large conspicuous blackish blotch between third and fourth spines. Second dorsal grey, ornamented with large irregular dark blotches and submarginal dark bands. Caudal pale except for darker lower part, where the fin is scattered with several pearl-white round spots. Anal dusky, sometimes indefinitely but broadly edged with black. Pectoral uniformly pale. Ventral pale, but the outer posterior margin more or less dark.

SEXUAL DIMORPHISM.—Remarkable sexual dimorphism exists in the form of fins in this species. It appears to be related to the age of the fish, inasmuch as it becomes conspicuous when the fish attains 82 mm in standard length. In the male, the first dorsal spine is produced into filament which is about as long as the head. The two median caudal rays are also produced and much longer than the others, and about 1.5 times as long as the head length. On the other hand, in the female, the first dorsal spine is scarcely longer than the second or third spine, and much shorter than the head. (Fig. 9A′) The two median caudal rays are more or less longer than the others, and about 1.2 times as long as the head length. (Fig. 9B′)

YOUNGS.—The hindmost hook on the preopercular spine is scarcely barbed in some youngs (Fig. 9D″). The first and fourth dorsal spines of the young males are a little longer than those of the young females.

REMARKS.—The present species is closely related to *Callionymus sokonumeri* KAMOHARA at least in having large eyes, elongated fins, the barbed hindmost preopercular hook and the peculiar coloration of the body, but they can sharply be separated from each other in the length and coloration of the vertical fins.

Table 6. Proportional measurements of dorsal spines, last dorsal soft ray and caudal fin against head length in adults (upper column) and youngs (lower column) of *Callionymus kaianus* GÜNTHER.

Sex / Items	Male		Female	
	Range	Average	Range	Average
1st dorsal spine	0.9–1.4	1.1	1.2–1.8	1.5
2nd dorsal spine	1.4–1.9	1.7	1.6–1.9	1.7
3rd dorsal spine	1.2–2.2	1.8	1.7–1.9	1.7
4th dorsal spine	2.2–3.4	2.8	2.5–3.2	2.6
Last dorsal ray	1.2–1.5	1.3	1.2–1.6	1.3
Caudal fin	0.5–0.8	0.7	0.7–1.0	0.8
1st dorsal spine	1.1–1.6	1.4	1.0–2.2	1.6
2nd dorsal spine	1.6–1.8	1.7	1.5–2.2	1.8
3rd dorsal spine	1.7–2.0	1.9	1.7–2.6	2.1
4th dorsal spine	2.6–3.5	3.0	2.6–5.5	3.7
Last dorsal ray	1.3–1.6	1.4	1.3–3.0	1.9
Caudal fin	0.6–0.7	0.7	0.7–0.9	0.8

Callionymus flagris Jordan et Fowler

Hatatate-numeri

(Fig. 11)

Callionymus flagris.—Jordan et Fowler, 1903 : 952-954, fig. 7 ; Jordan et Starks, 1904 : 598, fig. 1 ; Franz, 1910 : 84 ; Snyder, 1912 : 447 ; Jordan, Tanaka et Snyder, 1913 : 379, fig. 335 ; Ui, 1929 : 261 ; Kuroda, 1931 : 124 ; Böhlke, 1953 : 103.

Callionymus valenciennesi (not of Temminck et Schlegel).—Jordan et Hubbs, 1925 : 317-318 ; Schmidt, 1931 : 122 ; Tanaka, 1931 : 40 ; Kamohara, 1938 : 65 ; Fowler, 1941 : 22-23 ; Kamohara, 1952 : 90.

Material examined.—Male. No. 794, 103 mm in standard length (148 mm in total length), locality unknown. Nos. 10280-10284, 83-89 mm (125-137 mm), Obama, Fukui Pref., June 17, 1948. No. 17018, 65 mm (86 mm), Shimonoseki, March 9, 1951. Nos. 22102 22103, 90-94 mm (129-138 mm), Toyohama, Mie Pref., February 17, 1954. Nos. (Hokkaido Univ. Fish Coll.) 5438, 5441, 5443 and 5445, 70-100 mm (102-146 mm), Asamushi, Aomori Pref.

Female. No. 1259, 77 mm (100 mm), Owase, December 6-9, 1935. No. 1737, 99 mm (129 mm), Owase, January 4-8, 1936. Nos. 10279 and 10285-10290, 64-86 mm (84-112 mm), Obama, June 17, 1948. No. 16557, 68 mm (88 mm), Kunda, Kyôto Pref., June 1, 1951. Nos. (Hokkaido Univ. Fish Coll.) 5439-5440 and 5442, 75-79 mm (96.5-120 mm), Asamushi.

Description.—D. IV, 7 to 9 (8.8) ; A. 9 to 10 (9.1) ; C. 10. Head 3.7 to 4.4 (4.0) in standard length ; body width 5.7 to 9.5 (6.6) ; body depth 7.8 to 11.3 (9.5) ; depth of caudal peduncle 15.8 to 22.6 (19.4). Snout length 2.8 to 4.0 (3.1) in head length : eye diameter 2.6 to 3.6 (3.1) ; 1st dorsal ray 1.2 to 1.8 (1.3) ; 2nd dorsal ray 0.7 to 1.7 (1.3) ; 1st anal ray 2.3 to 3.6 (3.1) ; pectoral fin 1.0 to 1.3 (1.1) ; pelvic fin 0.8 to 1.1 (1.0).

Preopercular spine very short, about half as long as eye diameter, with three or four sharp hooks above, of which hindmost one directed upward and backward, but the others upward and forward ; a sharp spine directed forward at the base of the spine (Fig. 11D, D′).

Sexual dimorphism.—The present species shows also remarkable secondary sexual dimorphism in the coloration and the length of the fins (Table 7, fig. 11). So far as our observations go, such differences become significant at least when the fish attains 60 mm in standard length.

In the male, the dorsal spines are all greatly elongated except for the second one, and produced into filaments ; the first spine is the longest, sometimes extends to the base of the caudal fin when the fin is depressed, the second spine is the shortest and usually shorter than the head, the third and fourth spines are more or less longer than the head. The last dorsal soft ray is long, extending beyond the base of the caudal fin when the fin is laid back. The caudal fin is also elongated, the several median rays are produced into slender filaments beyond the general contour of the fin-membrane, and the longest one is about twice as long as the head (Fig. 11B). The last anal ray also extends to the base of the caudal peduncle. The first dorsal

fin is grey, provided with many whitish lines, dark spots and a blackish marginal crescentic blotch (Fig. 11A). Two or three rows of large blackish spots are set in lengthwise series on the base of the second dorsal fin. The anal fin is grey, becoming darker towards the outer margin (Fig. 11C).

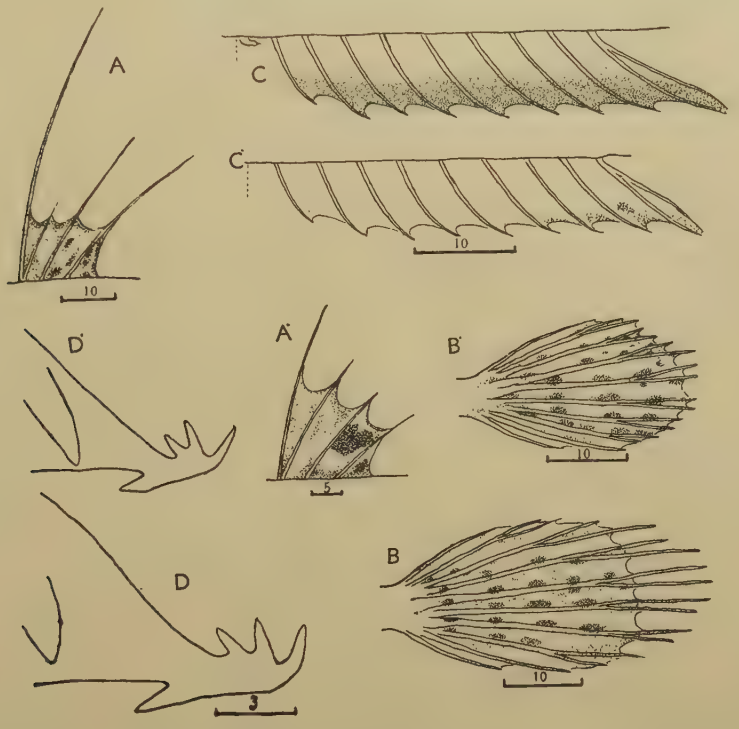

Fig. 11. First dorsal (A, A'), caudal (B, B'), anal (C, C') and preopercular spine (D, D') in *Callionymus flagris* JORDAN et FOWLER. A, B, C (No. 22103) and D (No. 172), male; A', B', C' (No. 22101) and D' (No. 169), female. Drawn by ARAGA.

Table 7. Proportional measurements of spines and rays against head length in *Callionymus fragris* JORDAN et FOWLER.

Sex / Items	Male		Female	
	Range	Average	Range	Average
1st dorsal spine	0.4–0.7	0.5	1.2–1.6	1.4
2nd dorsal spine	0.7–1.8	1.3	1.6–2.3	1.8
3rd dorsal spine	0.5–1.2	0.8	1.6–2.4	2.0
4th dorsal spine	0.5–1.0	0.8	2.1–2.8	2.5
6th dorsal ray	1.2–1.5	1.3	1.4–2.0	1.7
Last dorsal ray	0.6–1.0	0.8	1.3–1.9	1.6
Caudal fin	0.5–0.6	0.5	0.4–0.9	0.8

In the female, the dorsal spines are more or less filamentous and the first spine extends to the base of the second dorsal ray when the fin is depressed (Fig. 11A′). The last dorsal and anal rays are rather short, never reaching to the base of the caudal fin when the fins are depressed. The caudal rays are but little produced into filaments, and the longest one is slightly longer than the head (Fig. 11B′). The first dorsal fin is grey, provided with several irregular black blotches, of which the one laid between the third and fourth spines is larger and darker than the others (Fig. 11A′). The blackish brown spots on the second dorsal are smaller than those of the male. The anal fin is pale except for the dark margin on posterior part of the fin (Fig. 11C′).

Remarks.—Many authorities have accepted Jordan and Hubbs' view (1925 : 317) that *C. valenciennesi* Temminck et Schlegel is erroneously renamed as a new species, *C. flagris* by Jordan and Fowler (1903 : 952–954). However, the male of *C. valenciennesi* is obviously distinguished from that of the present species at least in having moderately elongated but shorter dorsal spines, the first spine being equal to the second in length. The last dorsal and anal soft rays are also shorter in the former, and never extend to the base of the caudal fin. In addition to these facts the caudal fin rays in the former are never filamentous, and the longest one is but slightly longer than the head.

Callionymus punctatus Langsdorff

Nezumi-gochi

(Fig. 12)

Callionymus punctatus.—Richardson, 1846 : 210.

Callionymus richardsoni.—Bleeker, 1854 : 414 ; Jordan et Hubbs, 1925 : 317 ; Schmidt et Lindberg, 1930 : 1150 ; Schmidt, 1931 a : 122 ; Schmidt, 1931 b : 143 ; Tanaka, 1931 : 40 ; Kuroda, 1951 : 386 ; Honma, 1952 : 225.

Callionymus curvicornis.—Günther, 1861 : 145 ; Ishikawa et Matsuura, 1897 : 37 ; Seale, 1914 : 79.

Callionymus valenciennesi.—Jordan et Fowler, 1903 : 950–952, fig. 6 ; Jordan et Starks, 1905 : 211 ; Smith et Pope, 1906 : 493 ; Snyder 1912 : 447 ; Jordan et Metz, 1913 : 59, fig. 59 ; Jordan, Tanaka et Snyder, 1913 : 374–375, fig. 333 ; Jordan et Thompson, 1914 : 293–294 ; Mori, 1928 : 8 ; Ui, 1929 : 261 ; Kamahora, 1936 : 4 ; Koike, 1936 : 13 ; Katayama, 1940 : 24 ; Boeseman, 1947 : 131–133 ; Chen, 1951 : 161 ; Mori, 1952 : 132.

Material examined.—Male. No. 4693, 151 mm in standard length (222 mm in total length), Owase, Mie Pref., December 1936. Nos. 11537–11538, 100–107 mm (135–152.5 mm), Chôshi, Chiba Pref., May 3, 1947. No. 12079, 135 mm (199 mm), Niigata, January and February, 1950. No. 15037, 154 mm (218 mm), Saheki Bay, Ôita Pref., January 3, 1951. Nos. 17080–17081, 136.5–142 mm (202–208 mm), Shimonoseki, September 26, 1950. No. 18599, 105 mm (146 mm), Mimase, Kôchi City., October 10, 1952. No. 19284, 104 mm (145 mm), Yôrô, Kyôto Pref., October 29, 1952. No. 21364, 118 mm (167 mm), lacality unknown. Nos. 21863–21865, 84–95 mm (112–131 mm), Mimase, April 10–20, 1954. Nos. 22082–22086, 136–152 mm (189–215 mm), Yorijima, Okayama Pref., March 3, 1954. Nos. 22092–22098, 22109 and 22115, 121–155 mm (159–209 mm),

Toyohama, Mie Pref., February 17, 1954. Nos. 23636–23637, 107–121 mm (152.5–163 mm), Yahatahama, Ehime Pref., October 10, 1954. Nos. 25092–25093, 141–142 mm (205.5–208 mm), Hakodate.

Female. No. 4606, 54 mm (68 mm), Kumanonada, October 20, 1936. No. 4699, 130 mm (175 mm), Owase, January 3, 1937. No. 7738, 152 mm (200 mm), Chôshi, February 16, 1944. No. 10250, 168 mm (226 mm), Hamada, Shimane Pref., May 13, 1948. No. 11538, 121 mm (156 mm), Chôshi, May 3, 1949. Nos. 16552, 16555 and 16556, 50–87 mm (65–115 mm), Kunda, June 1, 1951. No. 16815, 88 mm (115 mm), Ôsaka Bay, October 1950. No. 16962, 98 mm (132 mm), Miya, Aichi Pref., September 1951. Nos. 17077 and 17079, 86–90 mm (115–117 mm), Shimonoseki, June 11, 1951. No. 17168, 90 mm (117 mm), Miya, January 9–11, 1952. Nos. 18590–18591, 106–124 mm (142–168 mm), Mimase, October 10, 1952. No. 18796, 83 mm (108 mm), Yôrô, October 29, 1952. No. 20370–20371, 131–138 mm (177–179 mm), locality unknown. No. 20682, 118 mm (154 mm), Miya, April 10, 1953. No. 21365, 42 mm (54 mm), locality unknown. Nos. 21382 and 21386, 83–85 mm (103–110 mm), Miya, January 25, 1954. Nos. 22087–22091, 140-165.5 mm (184–217 mm), Yorijima, May 30, 1954. Nos. 22099, 22105–22108 and 22110–22114, 110.5–159 mm (144–215.5 mm), Toyohama, February 17, 1954. No. 23069, 131 mm (180 mm), Yahatahama, August 30, 1954. No. 23635, 100 mm (131 mm), Yahatahama, October 10, 1954. No. 24846, 104 mm (140 mm), Owase, October 25, 1954. Nos. (Hokkaido Univ. Fish Coll.) 5414–5417 and other two specimens, 68–135 mm (92–187 mm), Hakodate.

Description.—D. IV, 8 to 10 (9.0); A. 8 to 10 (9.0); P. 17–22 (19.2); C. 10. Head 3.5 to 4.8 (4.2) in standard length; body width 5.6 to 8.4 (6.6); body depth 8.4 to 11.8 (9.7); depth of caudal peduncle 16.7 to 23.9 (19.6). Snout length 1.8 to 3.9 (2.7) in head length; eye diameter 1.8 to 4.4 (3.6); 1st and 2nd dorsal soft rays each 1.1 to 1.8 (1.5); 6th dorsal soft ray 1.0 to 2.0 (1.5); 1st anal ray 1.9 to 3.1 (2.5); pectoral fin 0.8 to 1.5 (1.2); pelvic fin 0.7 to 1.2 (1.0).

Snout rather pointed, somewhat longer than eye diameter. Preopercular spine long, nearly as long as eye diameter, with three or four hooks above, and an antrorse spinule at the base (Fig. 12D, D′). The last dorsal and anal soft rays reach to or extend beyond base of caudal fin. The dorsal spines short, not filamentous. The caudal fin long, the median rays the longest, but the upper three rays remarkably shorter than the others (Fig. 12B, B′).

Sexual dimorphism.—Remarkable sexual dimorphism is also found to exist in this species in several external characters (Table 8, fig. 12). The difference becomes significant when the fish attains 95 mm in standard length.

In the male, the dorsal spines are subequal with each other in length except for the first one which is a little longer than the others (Table 8). The last dorsal ray extends beyond the base of the caudal fin by a distance approximately equal to the eye diameter. The caudal fin is greatly elongated in the median part, and about twice as long as the head length (Fig. 12B). Numerous light brown streaks run obliquely downward and forward on the sides of the body (Fig. 12C). The first dorsal is grey, with several irregular dark brown blotches, of which the one laid between the third and fourth is darker than the others, and sometimes it is even black. The membrane between the first to fourth dorsal spines is narrowly edged with black (Fig. 12A). The anal fin is grey, and broadly edged with black (Fig. 12C).

In the female, the first three dorsal spines subequal with each other, but the hindmost one is shorter than the others. The last dorsal ray reaches to or extends more or less beyond the base of the caudal fin. The caudal fin is shorter than in the male, but much longer than the head (Fig. 12B′). The lateral and under sides of the body and the anal fins are all uniformly pale (Fig. 12C′). The first dorsal is grey, with irregular dark blotches, and ocellated with black on the membrane between the third and fourth spines (Fig. 12A′).

There are some interesting male specimens (Nos. 18599, 22092 and 22115) which reveal female features in the coloration of the first dorsal fin. Their fin is not edged

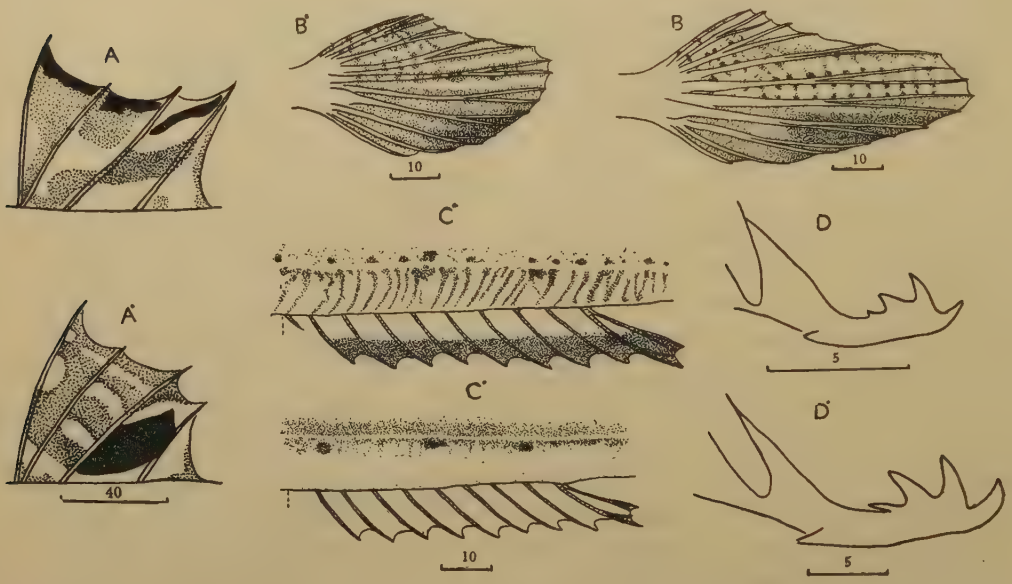

Fig. 12. First dorsal (A, A′), caudal (B, B′), anal (C, C′) and preopercular spine (D, D′) in *Callionymus punctatus* LANGSDORFF. A, B, C (No. 22083) and D (No. 19274), male; A′, B′, C′ and D′ (No. 23071), female. Drawn by OCHIAI and ARAGA.

Table 8. Sexual dimorphism found in some proportional measurements against head length in adults of *Callionymus punctatus* LANGSDORFF.

Sex / Items	Male		Female	
	Range	Average	Range	Average
1st dorsal spine	1.4–1.9	1.6	1.4–2.2	1.7
2nd dorsal spine	1.7–2.4	2.1	1.4–2.1	1.8
3rd dorsal spine	1.5–2.5	1.9	1.2–2.3	1.7
4th dorsal spine	1.4–3.3	2.1	1.5–3.1	2.5
Last dorsal ray	0.7–1.2	0.9	0.7–1.2	1.0
Caudal fin	0.5–0.7	0.6	0.5–0.8	0.7

with black but ocellated with black between the third and fourth spines as is the case with the female.

YOUNGS.—In the youngs, the dorsal spines, the last dorsal soft ray and the caudal fin are all much shorter than those of the adult. The first dorsal fin is always provided with a large black ocellus, but not edged with black.

REMARKS.—The observation of the first dorsal spine made by JORDAN and HUBBS (1925 : 317) agrees well with ours. In the female, the ocellus persists throughout life, but in the male it usually disappears, being gradually replaced by a black border on the fin and both the ocellus and black border exist together in the half-grown and even occasionally in the large adult male.

It is also pointed out by BOESEMAN (1947 : 131–133) that the fishes, Nos. 1011, 2079b and 2079c described as *C. valenciennesi* by TEMMINCK and SCHLEGEL, belong to the present species.

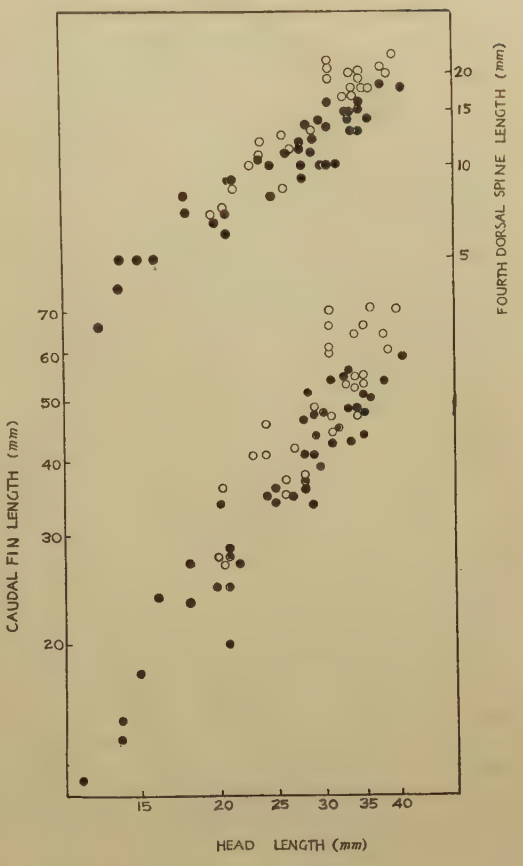

Fig. 13. Dimentions of 4th dorsal spine and caudal fin in *Callionymus punctatus* LANGSDORFF in relation to the head length. ○, male. ●, female.

Table 9. Proportional measurements of several body parts against head length in youngs of *Callionymus punctatus* LANGSDORFF.

Sex / Items	Male		Female	
	Range	Average	Range	Average
1st dorsal spine	1.8–1.9	1.8	1.8–3.0	2.1
2nd dorsal spine	2.1–2.3	2.2	1.8–3.0	2.0
3rd dorsal spine	2.0–2.5	2.3	1.6–3.2	2.2
4th dorsal spine	2.5–3.0	2.8	2.3–6.0	3.4
Last dorsal ray	0.8–1.1	1.0	1.1–2.0	1.4
Caudal fin	0.6–0.8	0.7	0.7–1.1	0.8

Callionymus lunatus Temminck et Schlegel

Nezuppo: Numeri-gochi

(Figs. 14–15)

Callionymus lunatus.—Temminck et Schlegel, 1845 : 155, pl. 78, fig. 4 ; Günther, 1861 : 146 ; Günther, 1879 : 28, 67–68 ; Jordan et Fowler, 1903 : 949–950, fig. 5 : Jordan et Starks, 1904 : 598 ; Regan, 1905 : 24–25 ; Smith et Pope, 1906 : 493 ; Franz, 1910 : 84 ; Snyder, 1912 : 446 ; Jordan, Tanaka et Snyder, 1913 : 374, fig. 332 ; Jordan et Thompson, 1914 : 294, fig. 70 ; Jordan et Hubbs, 1925 : 316–317 ; Mori, 1928 : 8 ; Ui, 1929 : 225 ; Schmidt, 1930 : 1150 ; Kuroda, 1931 : 124 ; Nakamura, 1934 : 25 ; Mori et Uchida, 1934 : 21 ; Koike, 1936 : 13 ; Kamohara, 1938 : 65 ; Boeseman, 1947 : 133 ; Mako, 1949 : 134 ; Katayama, 1950 : 10 ; Chen, 1951 : 161 ; Honma, 1952 : 225 ; Kamohara, 1952 : 90 ; Mori, 1952 : 132.

Callionymus lunatus form *lunatus*.—Kuroda, 1951 : 386.

Callionymus lunatus form *usuiro*.—Kuroda, 1951 : 386 ; Kuroda, 1952 : 173–174.

Material examined.—Male. Nos. 748–780, 782–785, 787–794, 795–810, 812–828, 830–848, 850, 852–855 and 857–867, 91–137 mm (121–186 mm), locality unknown. Nos. 5483–5486, 122–130 mm (158–174 mm), Chôshi, Chiba Pref., November 20–26, 1937. No. 8811, 112 mm (142 mm), Kanaiwa, Ishikawa Pref., October 26 1942. No. 10186, 124 mm (165 mm), Kasumi, Hyôgo Pref., March 28, 1948. No. 10545, 145 mm (195 mm), Maizuru, Kyôto Pref., December 1, 1948. No. 11295, 139 mm (186 mm), Chôshi, April 4, 1949. No. 11496, 122 mm (160 mm), Wakasa Bay, April 28, 1949. No. 11534, 126 mm (170 mm), Chôshi, May 3, 1949. Nos. 13057 and 13063, 104–142 mm (138–190 mm), Wakasa Bay, May 1950. No. 14502, 126 mm (154 mm), Maizuru, October 1950. Nos. 16467, 16503, 16509, 16511–16524, 16526–16535, 16537–16547, 16549 and 16550, 91–144 mm (123–194 mm), Kunda, Kyôto Pref., June 1, 1951. Nos. 18587–18589, 18592–18594 and 18598, 91–122 mm (121–161 mm), Mimase, Kôchi City, October 10, 1952. No. 20203, 121 mm (161 mm), Wakasa Bay, November 10, 1952. Nos. 19187–19188, 120–131 mm (165–174 mm), Owase, Mie Pref., November 11–15, 1952. Nos. 21175–21200, 111–143 mm (136–194 mm), Owase, November 5, 1953. Nos. 21313–21338, 112–147 mm (153–196 mm), Wakasa Bay, October 27, 1953. No. 24797, 67 mm (90 mm), Owase, October–November, 1954.

Female. Nos. 781 and 786, 112–113 mm (143–147 mm), locality unknown. Nos. 1710, 1713–1716, 1718, 1720–1721, 1723–1724, 1726, 1728–1732, 1734 and 1738–1746, 88–125 mm (116–160 mm), Owase, January 4–8, 1936. No. 5485, 84 mm (107 mm), Chôshi, November 20–26, 1937. Nos. 8812–8814, 101–110 mm (130–145 mm), Kanaiwa, October 26, 1942. Nos. 9090–9091, 11290 and 11296, 92–138 mm (119–176 mm), Tsuiyama, Hyogo Pref., May 12, 1943. No. 11497, 139 mm (178 mm), Wakasa Bay, April 28, 1949. Nos. 11535 and 11540, 123–133 mm (160–174 mm), Chôshi, May 3, 1949. No. 13049, 13050 and 13069, 116–139 mm (150–179 mm), Wakasa Bay, May 1950. No. 14501, 146 mm (187 mm), Maizuru, October 1950. Nos. 15131 and 15135, Owase, January 16–18, 1950. Nos. 16431–16435, 16437–16466, 16468–16477, 16481, 16485, 16487–16490, 16493–16499, 16501–16502, 16505–16507, 16525, 16536 and 16548, 88–128 mm (116–164 mm), Kunda, June 1, 1951. Nos. 21150, 21153–21155 and 21157–21168, 81–156 mm (103–201 mm), Owase, November 5, 1953. Nos. 21339–21348, 21384 and 21389, 47.5–135 mm (61.5–169 mm), Miya, Aichi Pref., January 25, 1954.

Description.—D. IV to V, 8 to 10 (9.0) ; A. 8 to 9 (9.0) ; P. 18 to 21 (19.7) ; C. 10. Head 3.5 to 4.9 (4.0) in standard length ; body width 5.3 to 8.5 (6.6) ; body depth 7.3 to 11.3 (9.4) ; depth of caudal peduncle 15.3 to 25.5 (20.8). Snout length 2.1 to 3.7 (3.0) in head length ; eye diameter 2.4 to 3.9 (3.1) ; interorbital width 8.3 to 26.0 (16.5) ; 1st dorsal ray 1.1 to 1.8 (1.5) ; 2nd dorsal soft ray 1.2 to 1.9 (1.6) ; 6th

dorsal soft ray 1.4 to 2.5 (1.9); 1st anal ray 2.2 to 3.6 (2.8); pectoral fin 0.8 to 1.3 (1.1); pelvic fin 0.8 to 1.3 (1.1).

Snout rather pointed, about as long as eye diameter. Preopercular spine shorter than eye, armed with three or four hooks above, and a short spinule directed forward at the base (Fig. 14D, D′). Caudal fin rounded, without filaments.

SEXUAL DIMORPHISM.—In the present species, there exists marked secondary sexual dimorphism in both the length and coloration of the first dorsal, caudal and anal fins (Table 10, figs. 14–15). In the male, the first dorsal spine is thickend and produced into a long filament, sometimes extending nearly to the base of the caudal fin when the fin is depressed, but others are slender, shorter and subequal in length to each other (Fig. 14A). The last dorsal soft ray is long, the tip extending as

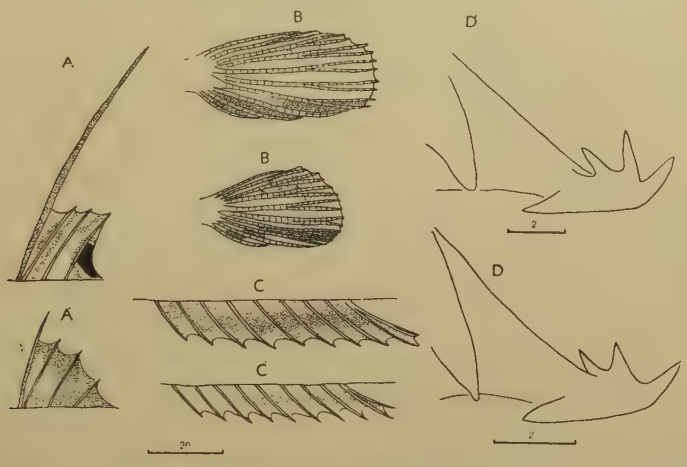

Fig. 14. First dorsal (A, A′), caudal (B, B′), anal (C, C′), and preopercular spine (D, D′) in *Callionymus lunatus* TEMMINCK et SCHLEGEL. A, B, C (No. 21317) and D (No. 21190), male; A′, (No. 15131), B′, C′ (No. 21343) and D′(No. 21346), female. Drawn by OCHIAI and ARAGA.

Table 10. Sexual dimorphism found in some proportional measurements against head length in *Callionymus lunatus* TEMMINCK et SCHLEGEL.

Sex / Items	Male		Female	
	Range	Average	Range	Average
1st dorsal spine	0.4–0.8	0.6	1.3–2.3	1.9
2nd dorsal spine	1.3–2.6	1.9	1.4–3.3	2.6
3rd dorsal spine	1.5–2.1	1.7	1.8–4.2	2.8
4th dorsal spine	1.5–3.1	1.9	3.2–6.3	5.0
Last dorsal ray	0.8–1.2	1.0	1.0–2.1	1.5
Caudal fin	0.7–1.1	0.8	0.6–1.0	0.9

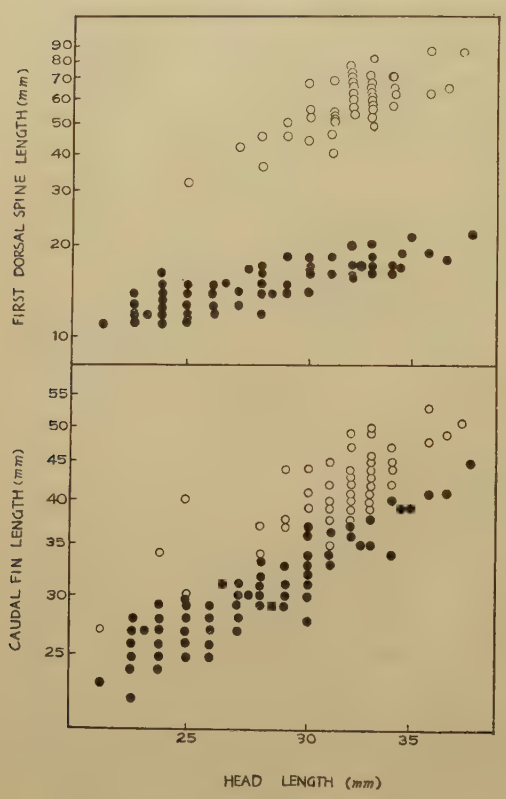

Fig. 15. Dimentions of first dorsal spine and caudal fin in *Callionymus lunatus* Temminck et Schlegel in relation to the head length. ○, male. ●, female.

far beyond the base of the caudal fin when the fin is depressed. The caudal fin is rounded and rather longer than the head length (Fig. 14B). The last anal soft ray is also long, and reaches to the base of caudal fin. The first dorsal fin is pale, marked with irregular dark streaks, and ocellated[1] with black on the membrane behind the last dorsal spine (Fig. 14A). The lower edge of the caudal fin is uniformly black (Fig. 14B). The anal fin is dark, and darker along the median axis of the fin (Fig. 14C).

In the female, the dorsal spines are short and never reaches to the origin of the second dorsal fin when the spines are depressed. The last dorsal and anal soft rays are short, scarcely extend to the base of the caudal fin. The caudal fin is obliquely truncated and the longest lower ray is nearly as long as the head (Fig. 14B). The first dorsal fin is black, but the basal region is somewhat light (Fig. 14A′). The lower part of the caudal fin is dark, edged with white (Fig. 14B′). The anal fin is pale, with a dark band along the median axis of the fin (Fig. 14C′).

Remarks.—By Kuroda (1952 : 174, fig. 6), the present species is splitted into two forms (form. *lunatus* and form. *usuiro*) based mainly upon the length of the first dorsal spine and the general coloration of the body. Of these two forms, *C. lunatus* form. *usuiro* is characterized by having a body much lighter and the first dorsal spine in the male much longer, extending nearly as far beyond the base of the caudal fin. Already, Schmidt (1931 b : 142–143) pointed out that in some specimens of this species taken from Japan, the first dorsal spine extends to the base of the last dorsal soft ray when the spine is depressed backward. It can hardly be justifiable to accept

1) Occasionally, the ocellus is more or less broken up (Snyder, 1912 : 446). In one of our specimen (No. 23578) taken at Wakasa Bay, the fin is furnished with two blackish ocelli, the one placed on the general place and the other laid between the third and fourth spines. But the latter is more or less lighter than the former.

KURODA's opinion, inasmuch as the first dorsal spine in the male strikingly increases in length with the growth of the fish,[1] and there can be found no significant correlation between the length of the spine and the general coloration of the body.

The description of this species given by JORDAN and FOWLER (1903 : 945–950) contains some erroneus points in the coloration of the anal and caudal fins of the male. The characteristics given by them on these fins are indeed those of the female. According to their descriptions the illustration of this species appears to be based upon a male. But it should be mentioned that their illustration shows clearly the female features in both the form and coloration of the first and second dorsal, caudal and anal fins.

Callionymus huguenii BLEEKER

Nagasaki-numeri

Callionymus huguenii.—GÜNTHER, 1861 : 145–146 ; JORDAN et FOWLER, 1903 : 995–956 ; JORDAN, TANAKA et SNYDER, 1913 : 377.
? *Callionymus huguenii.*—ISHIKAWA et MATSUBARA, 1897 : 37.
? *Callionymus higuenii.*—SCHMIDT, 1931 b : 144.

The present species was described by BLEEKER from a single specimen, which appears to be male. No specimens have come under our examination, but according to the original description the species is characterized in the following points: dorsal and anal soft rays each 10; preopercular spine not longer than eye diameter, terminating in three large curved hooks; first dorsal with filiform spines, the first being the longest, much longer than head; caudal fin pointed, as long as head; first dorsal plain; anal edged with black.

It is doubtful whether ISHIKAWA and MATSUURA's (1897 : 37) *C. huguenii* taken from Hakodate, Prov. Hokkaido, really belongs to this species or not. Also, we doubt the conclusion that a young female found at Misaki and described as *C. higuenii* by SCHMIDT (1931 b : 144) is identical to this species.

Callionymus beniteguri JORDAN et SNYDER

Tobi-numeri

(Figs. 16–17)

Callionymus beniteguri.—JORDAN et SNYDER, 1900 : 370–371, pl. 42 ; JORDAN et FOWLER, 1902 : 956–957 ; FRANZ, 1910 : 84 ; SNYDER, 1912 : 447 ; JORDAN, TANAKA et SNYDER, 1913 : 375 ; JORDAN et HUBBS, 1925 : 317 ; SCHMIDT, 1931 : 143 ; FOWLER, 1941 : 22 ; HIKITA, 1951 : 311 ; HONMA, 1952 : 226 ; BÖHLKE, 1953 : 103.

1) Holotype of *Callionymus lunatus* form. *usuiro* (♂) is 146 mm in standard length. So far as our observations go, the first dorsal spine greatly increases in length (about 75 mm) when the male attains that size.

Callionymus ornatipinnis.—Regan, 1905 : 24, pl. 3; Jordan, Tanaka et Snyder, 1913 : 375.
? *Callionymus kanekonis.*—Tanaka, 1917 : 7–12; Tanaka, 1931 : 40.

Material examined.—Male. Nos. 4692 and 6495–6497, 104–115 mm (142–153 mm), Owase, Mie Pref., December 1936. No. 9736, 131 mm (166 mm), Shiogama, Miyagi Pref., November 1, 1944. No. 10304, 130 mm (170 mm), Funakawa, Akita Pref., June 1948. No. 11541, 142 mm (198 mm), Chôshi, Chiba Pref., May 3, 1949. Nos. 16811–16814, 82–120 mm (108–155 mm), Ôsaka, October 1950. No. 17399, 66 mm (90 mm), Owase, January 3–7, 1952. Nos. 20683 and 20684, 100–113 mm (127–148 mm), Miya, Aichi Pref., April 10, 1953. No. 23059, 121 mm (170 mm), Maizuru, August 26, 1954. Nos. (Hokkaido Univ. Fish Coll.) 5482–5488, 98–153 mm (129–207 mm), Oshoro, Prov. Hokkaido.

Female. No. 23060, 102 mm (140 mm), Maizuru, August 26, 1954. No. (Hokkaido Univ., Fish Coll.) 5489, 82 mm (107 mm), Muroran, Prov., Hokkaido.

Description.—D. IV, 8 to 9 (9.0); A. 9; P. 18 to 22 (19.8); C. 10. Head 3.6 to 4.2 (4.0) in standard length; body width 5.9 to 7.4 (6.2); body depth 8.2 to 12.3 (10.0); depth of caudal peduncle 17.3 to 23.5 (20.4). Snout length 2.1 to 2.7 (2.5) in head length; eye diameter 2.2 to 4.5 (3.7); interorbital width 8.9 to 22.0 (12 5); 1st dorsal soft ray 1.6 to 2.0 (1.7); 2nd dorsal soft ray 1.4 to 2.1 (1.8); 6th dorsal soft ray 1.4 to 2.1 (1.8); 1st anal ray 2.7 to 3.7 (3.0); pectoral fin 1.2 to 2.0 (1.4); pelvic fin 0.8 to 1.4 (1.0); caudal fin 0.6 to 1.0 (0.8).

Snout broad, pointed and much longer than eye. Interorbital space rather wide and strongly concave, about 1/3 as wide as eye diameter. Preopercular spine very short, about half as long as eye diameter, with three or four hooks above, and a spinule directed forward at base (Fig. 17D, D′). Last dorsal and anal soft rays reach to or extending beyond base of caudal fin.

Sexual dimorphism.—Remarkable sexual dimorphism exists in the length and coloration of the dorsal caudal and anal fins (Table 11, figs. 16–17). This divergence becomes conspicuous when the fish reaches to at least 82 mm in standard length. In the male, the anterior two dorsal spines are long, slender, ending in filaments and

Fig. 16. Lateral view of *Callionymus beniteguri* Jordan et Snyder (male): No. 23059, 121 mm in standard length. Drawn by Ochiai.

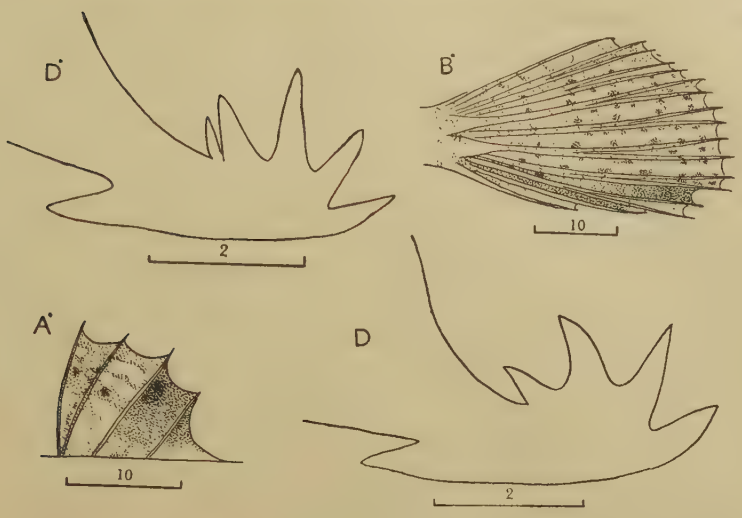

Fig. 17. First dorsal (A'), caudal (B') and preopercular spine (D, D') in *Callionymus beniteguri* JORDAN et SNYDER. D (No. 23059), male; A', B', and D' (No. 23060), female. Drawn by OCHIAI.

Table 11. Sexual dimorphism in some proportional measurements against head length in *Callionymus beniteguri* JORDAN et SNYDER.

Sex / Items	Male		Female
	Range	Average	Range
1st dorsal spine	1.0–2.0	1.4	2.2–2.5
2nd dorsal spine	0.8–1.9	1.4	2.2
3rd dorsal spine	1.5–2.5	1.9	2.5–3.2
4th dorsal spine	2.5–4.7	3.2	3.9–4.4
Last dorsal ray	0.9–1.4	1.1	1.4–1.5
Caudal fin	0.6–1.0	0.8	0.7–0.9

sometimes extend to the base of the fourth dorsal soft ray when the fin is depressed, but the two posterior spines are much shorter. The last dorsal soft ray is greatly elongated, and the tip extends as far beyond the base of the caudal fin. The three median caudal rays are longer than the others. The anal fin is rather low, and the last ray extends a little beyond the base of the caudal fin. The first dorsal fin is grey, speckled with white spots and streaks, and membrane between the third and fourth spines is edged with black spots. The second dorsal is grey, furnished with two or three longitudinal rows of conspicuous blackish spots which are about as long as the interorbital width. The anal fin is either uniformly pale, or black dyed with numerous oblique wavy light streaks.

In the female, the dorsal spines are all short and never filamentous (Fig. 17A'), the last dorsal and anal soft rays are rather short, but extend to the base of the

caudal fin. The caudal fin is rather short and rounded (Fig. 17B′). The first dorsal fin is provided with numerous dusky lines and white blotches on the membrane of the first three spines, but the rest of the fin is rather black (Fig. 17A′). The blackish spots placed on the second dorsal are shorter than the interorbital width. The anal fin is uniformly pale.

Remarks.—Variety of this species found in the coloration of the body has already been pointed out by Jordan and Fowler (1903 : 957). Two types may be distinguished in the coloration of the anal fin as aforementioned. Our male specimens characterized by the striped anal fin agree well with the female paratypes of the present species. While, the males with uniformly pale anal fins accord with the holotype of *Callionymus ornatipinnis* Regan in every feature.

Callionymus kanekonis Tanaka, which is thought to be a synonym of this species, is allied well with the present species in length of the first dorsal spine, the preopercular spine, the last dorsal ray, and the coloration of the body and fins, but the head is slightly larger (3 1/3 in standard length) and the snout is more or less shorter (3 1/3 in head length).

Callionymus valenciennesi Temminck et Schlegel

Hatatate-damashi (new Japanese name)

Callionymus valenciennesi.—Temminck et Schlegel, 1845 : 153, pl. 73, fig. 3 ; Brevoort, 1856 : 271 ; Jordan et Hubbs, 1925 : 317–318 (in part) ; Boeseman, 1947 : 131–133.

No specimens have come under our examination, but according to the original description and figure, the characteristics of this species (male) are summarized as follows: dorsal spines all filamentous, nearly twice as high as the membrane, first and second spines greatly produced, somewhat longer than head ; soft dorsal and anal rather short, their last rays not extend to base of caudal fin ; caudal not filamentous ; first dorsal pale with a few large dark specks ; anal pale edged with black.

In his revision of the Japanese fishes collected by Burger and von Siebold, Boeseman (1947 : 131–133) annotated that a specimen (No. 2078) must be the fish which represented as a male of *C. valenciennesi* of Temminck et Schlegel, but other specimens (Nos. 2079 a, b and 1011) may belong to either *C. beniteguri* Jordan et Snyder or *C. punctatus* Langsdorff.

Callionymus virgis Jordan et Fowler

Horo-numeri

(Figs. 18–19)

Callionymus virgis.—Jordan et Fowler, 1903 : 957–958, fig. 9 ; Franz, 1910 : 85 ; Jordan, Tanaka et Snyder, 1913 : 376, fig. 336 ; Kamohara, 1938 : 65 ; Kuroda, 1951 : 386 ; Kamohara, 1952 : 89 ; Kuroda, 1952 : 174 ; Böhlke, 1953 : 104 ; Kuroda, 1954 ; 160-161.

MATERIAL EXAMINED.—Male. Nos. 11297–11299, 48–55 mm (60.5–68 mm), Tsuiyama, Hyôgo Pref., June 4, 1949. Nos. 13063, 13068, 13070–13073 and 13075, 52–60 mm (65–76 mm), Wakasa Bay, May 1950. No. 15295, 57 mm (73 mm), Owase, Mie Pref., January 15–20, 1950. Nos. 16558–16560, 45–51 mm (55–67 mm), Kunda, Kyôto Pref., June 1, 1951. Nos. 18596 and 18597, Mimase, Kôchi City, October 10, 1952. No. 18738, 83 mm (105 mm), Urado, Kôchi City, October 15, 1952. Nos. 21896–21908 and 21910–21936, 52–79.5 mm (67–104 mm), Mimase, April 10–20, 1954. Nos. 24818–24821, 24823–24824 and 24825–24845, 40–71 mm (53–92 mm), Owase October 25, 1954.

Female. Nos. 11291, 11293 and 11294, 41–48.5 mm (51–62 mm), Tsuiyama, April 1949. Nos. 13074 and 13076, 47.5–53 mm (62.5–69 mm), Wakasa Bay, May 1950. Nos. 21869, 21871 and 21872, 48.5–50.5 mm (61–65 mm), Mimase, April 10–20, 1954.

DESCRIPTION.—D. IV, 8 to 10 (9.0); A. 8 to 10 (9.0); P. 17 to 21 (19.0); C. 10. Head 3.7 to 4.9 (4.3) in standard length; body width 4.4 to 7.3 (6.2); body depth 7.9 to 16.6 (10.5); depth of caudal peduncle 16.0 to 23.3 (19.9). Snout length 2.6 to 4.0 (3.3) in head length; eye diameter 2.0 to 3.7 (3.0); interorbital width 9.5 to 19.0 (14.7); 1st dorsal soft ray 1.0 to 1.4 (1.2); 2nd dorsal soft ray 0.9 to 1.9 (1.3); 1st anal soft ray 1.9 to 3.7 (2.7); pectoral fin 0.8 to 1.3 (1.1); pelvic fin 0.6 to 1.3 (1.0); caudal fin 0.7 to 1.1 (0.8).

Snout pointed and more or less shorter than eye diameter. Preopercular spine rather short, nearly half as long as eye diameter, armed with three or four conspicuous hooks above, the hindmost one turning upward and backward, but the others upward and forward; a spinule directed forward at the base (Fig. 18D, D′). Caudal fin not elongate. Anal pale, with faint dark streaks on the membrane.

SEXUAL DIMORPHISM.—This species displays most remarkable sexual dimorphism in this group (Table 12, fig. 18). The dimorphism becomes significant when the fish attains at least 40 mm in standard length. In the male, the dorsal spines are all very long, filamentous, and subequal in length. The membrane of the first dorsal fin is very high and joined to the first dorsal soft ray (Fig. 18A). The last dorsal soft ray extends as far as the base of the caudal fin, but the last anal soft ray scarcely reaching it when the fin is depressed. The first dorsal fin is grey, furnished with some irregular vertical light streaks; the base and the first spine are black (Fig. 18A).

Table 12. Sexual dimorphism found in some proportional measurements against head length in *Callionymus virgis* JORDAN et FOWLER.

Sex / Items	Male		Female	
	Range	Average	Range	Average
1st dorsal spine	0.3–0.7	0.4	1.5–1.9	1.7
2nd dorsal spine	0.3–0.6	0.4	1.7–2.2	1.8
3rd dorsal spine	0.3–0.5	0.3	1.8–2.8	2.2
4th dorsal spine	0.3–0.6	0.4	2.5–3.5	2.9
6th dorsal ray	1.2–2.1	1.5	1.9–2.7	2.1
Last dorsal ray	0.7–1.3	1.0	1.5–1.7	1.7

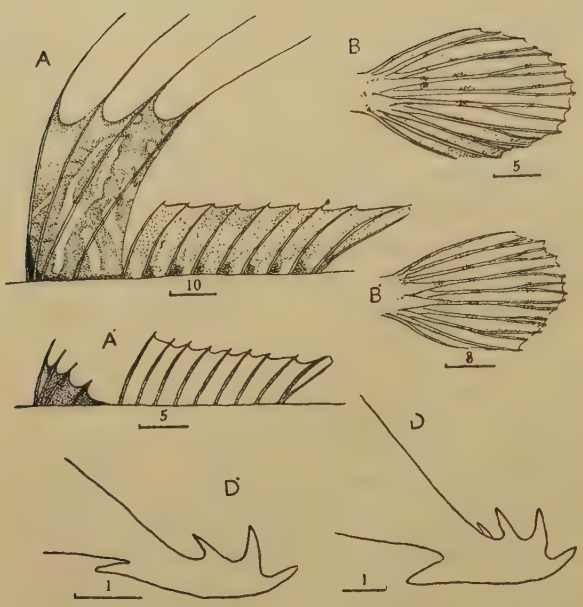

Fig. 18. First dorsal (A, A′), caudal (B, B′) and preopercular spine (D, D′) in *Callionymus virgis* JORDAN et FOWLER. A, B (No. 21902) and D (No. 21931), male; A′, B′ (No. 21972) and D′ (No. 21871), female. Drawn by ARAGA.

Fig. 19. Upper view of *Callionymus virgis* JORDAN et FOWLER (female): No. 21869, 48.5 mm in standard length. Drawn by ARAGA and OCHIAI.

The second dorsal fin is pale and ornamented with blackish blotches at the base of the caudal.

In the female, the dorsal spines are all short, and the membrane is neither high nor joined to the second dorsal fin (Fig. 18A, A′). The last dorsal and anal soft rays are not extending to the base of the caudal fin. The first dorsal fin is uniformly brownish black. The second dorsal fin is almost pale and without any markings (Fig. 18A′).

REMARKS.—In our regions, the male of the present species is rather common

together with *Callionymus flagris* JORDAN et FOWLER, but the female has never been found for a long time until some specimens were reported from Prov. Izu by KURODA (1954 : 160–161).

Callionymus kitaharai[1] JORDAN et SEALE

Kuro–numeri

Callionymus kitaharae.—JORDAN et SEALE, 1906 : 148, fig. 6 ; JORDAN, TANAKA et SNYDER, 1913 : 375, fig. 334 ; MORI, 1952 : 132 ; BÖHLKE, 1953 : 103.

No specimens have come under our examination, but from the original description and figure, the present species is characterized in the following points : eye (2.5 in head length) larger than snout (3.0 in head length) ; preopercular spine distinctly shorter than eye, with four hooks on the upper edge, and the basal spinule directed forward ; dorsal spines short, the first the longest, scarcely longer than eye ; second dorsal becomes gradually shorter posteriorly ; last dorsal and anal soft rays not extend to base of caudal fin ; a dark blotch crescentic in shape present on spinous dorsal between second and third spines, and a similar but larger one between third and fourth spines.

This fish accords well with the female of *Callionymus virgis* JORDAN et FOWLER in numerous characteristics except for the coloration of the first dorsal. In the latter the fin is uniformly black.

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